SCIENTIFIC AMERICAN SUPPLEMENT. No. 1389

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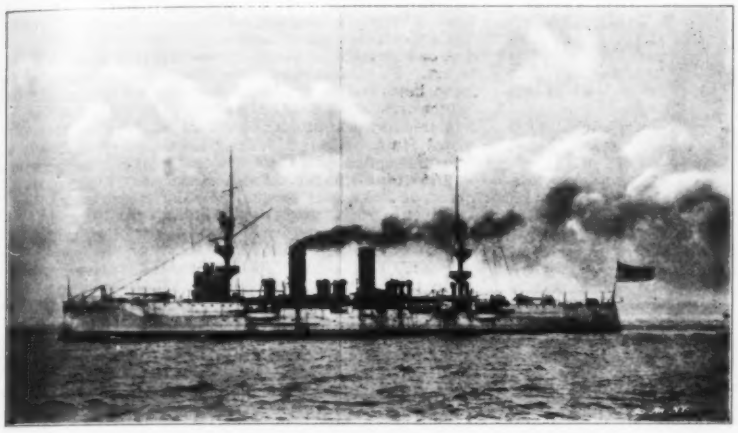
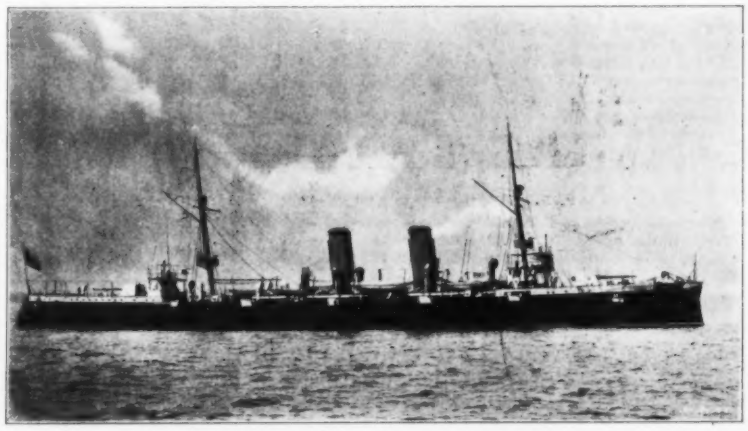
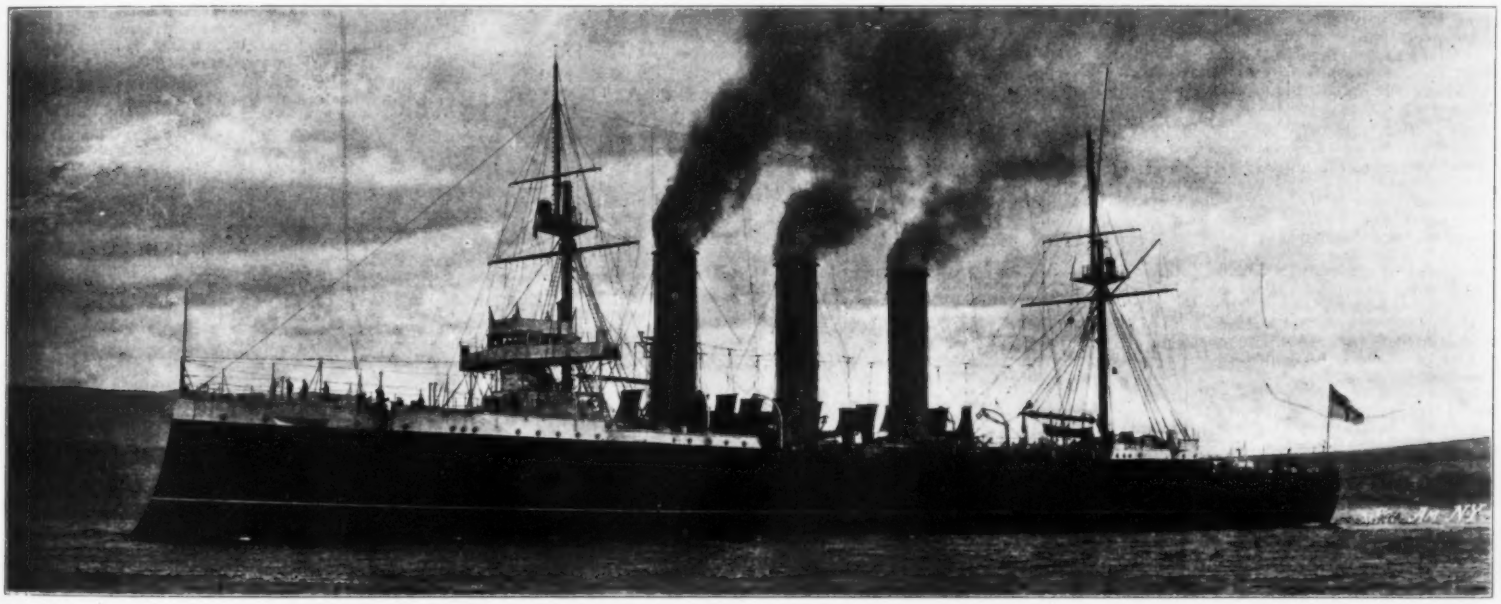
Scientific American, established 1845.
Scientific American Supplement, Vol. LIV, No. 1389. NEW YORK, AUGUST 16, 1902. Scientific American Supplement, $5 a year.
Scientific American and Supplement, $7 a year.



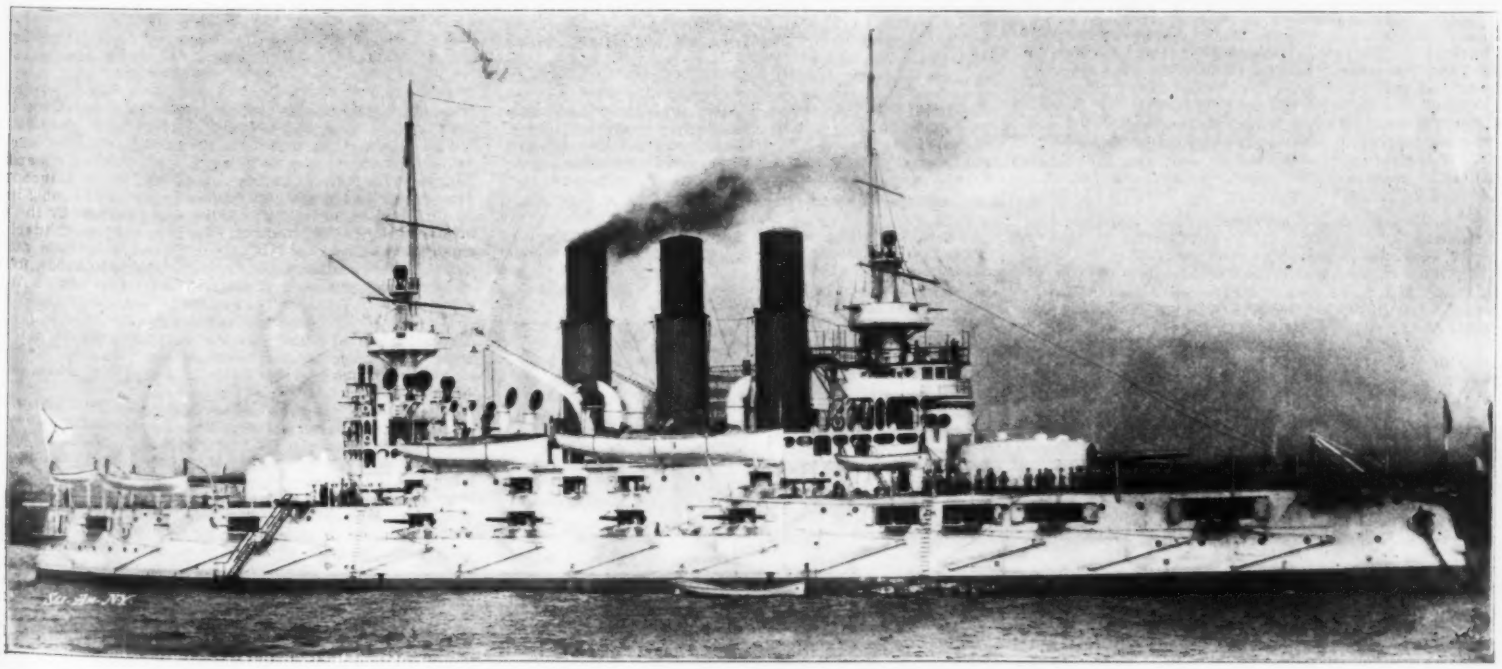
UNITED STATES. PROTECTED CRUISER "ALBANY." DISPLACEMENT, 3,769 TONS. SPEED, 20 KNOTS.



CHILI. PROTECTED CRUISER "CHACABUCO." DISPLACEMENT, 4,500 TONS. SPEED, 23 KNOTS.



GREAT BRITAIN. ARMORED CRUISER "BEDFORD." DISPLACEMENT, 9 800 TONS. SPEED, 23 KNOTS



RUSSIA. BATTLESHIP "POBIEDA." DISPLACEMENT, 12,674 TONS. SPEED, 18 KNOTS.

WARSHIPS AT SPITHEAD FOR THE CORONATION NAVAL REVIEW.

WARSHIPS AT SPITHEAD FOR THE CORONATION NAVAL REVIEW.

From our London Correspondent.

ALTHOUGH the great Coronation Naval Review was postponed from June 28 to August 16 because of the illness of His Majesty King Edward VII., many thousands of people had an opportunity of seeing the magnificent gathering of ships, British and foreign, that originally was drawn up in imposing array in the famous anchorage at Spithead. The news of the King's illness arrived on Tuesday and on Thursday the foreign contingent began to disperse, the French cruiser "Montcalm" being the first to leave. It was my good fortune to see most of the foreign vessels before they left and to be enabled to compare them with the British men-of-war in the lines.

The newest British battleship was H.M.S. "London," the flagship of Admiral Sir C. F. Hotham, commander-in-chief of the fleet at Spithead. She belongs to the "Formidable" class. Her displacement is 15,000 tons, indicated horse power 15,000 and speed 18 knots; length 400 feet, beam 75 feet, draught 26 feet 9 inches; armament, twelve 6-inch, 32 smaller guns and two torpedo tubes; complement, 755 officers and men.

No representative of the "Duncan" class was present, although the "Exmouth" and the "Russell" have both completed their trials. This class has a speed of 19 knots and a displacement of 14,000 tons. There was no representative of the "Canopus" class, the next newest battleship being the six "Majestics," viz., "Majestic," "Magnificent," "Prince George," "Jupiter," "Mars" and "Hannibal." Each of these displaces 14,900 tons, has an indicated horse power of 12,000 and a speed of 17½ knots. The armament consists of four 12-inch, twelve 6-inch, eighteen 12-pounders, twelve 3-pounders, eight machine guns and five torpedo tubes. Next in point of age came the three of the "Royal Sovereign" type, viz., "Empress of India," "Resolution" and "Revenge," each of 14,150 tons displacement; the two of the "Nile" type, viz., "Nile" and "Trafalgar"; the "Sans Pareil," and the four "Admirals"—"Anson," "Camperdown," "Benbow" and Collingwood." Of second class battleships there were two, viz., "Edinburgh" and "Devastation." The last-named was the oldest battleship present in the lines, for she was launched so far back as 1871. Of third class battleships there were two, namely, "Hero" and "Conqueror."

Turning now to the cruisers, the "Sutlej" is one of six cruisers known as the "Cressy" class. Each displaces 12,000 tons, has an indicated horse power of 21,000 and a speed of 21 knots. The broadside armor is 6 inches thick and the armament consists of two 9.2-inch, two 6-inch, twelve 12-pounders and smaller weapons, as well as two torpedo tubes. The next in size, but newer in design, is the armored cruiser "Bedford," of 9,800 tons and contract speed of 23 knots. The next in age were the "Niobe" and "Ariadne," with no broadside armor, but with protected gun positions, and armored decks. The "Hawke" and "St George" are not protected as to all of their guns. The five other first class cruisers, viz., "Narcissus," "Immortalite," "Orlando," "Australia" and "Galatea," carry a very narrow belt of plating on the water-line. The other cruisers do not call for much notice. They were as follows: "Hyacinth" type, 5,600 tons—"Hyacinth," "Doris," "Juno," "Minerva," "Furious," 5,750 tons; "Severn," 4,050 tons. "Apollo" type, 3,400 to 3,600 tons—"Apollo," "Andromache," "Melampus," "Retribution," "Scylla," "Brilliant," "Rainbow."

Turning now to the foreign warships sent to Spithead for the Coronation Naval Review, these were eighteen in number.

The following is a list of the foreign warships: Battleships—Germany, "Kaiser Friedrich III."; Russia, "Pobieda"; United States, "Illinois"; Greece, "Psara." Armored cruisers—Denmark, "Herluf Trolle"; France, "Montcalm"; Italy, "Carlo Alberto"; Spain, "Emperador Carlos V."; Japan, "Asama." Protected cruiser—Japan, "Takasago." Cruising ships—Chili, "Chacabuco"; Netherlands, "Holland"; Portugal, "Don Carlos I." Coast defence ships (armored)—Norway, "Norge"; Sweden, "Oden." Training ship—Argentine Republic, "Presidente Sarmiento." Torpedo boat destroyers—Japan, "Asashio"; Austria-Hungary, "Szigetvar."

A few details respecting these vessels may be of interest. The Japanese ships, "Asama" and "Takasago," have both been built by Messrs. Sir L. G. Armstrong, Whitworth & Co., of Elswick. The "Asama" is an armored cruiser and she will fly the flag of Rear-Admiral Ijuin. She has a length of 7,408 feet, beam 67 feet and a draught 24 feet 3 inches; her displacement is 9,750 tons and indicated horse power 19,000, giving a speed of 22 knots. She carries four 8-inch quick-firing, fourteen 6-inch, twelve 12-pounders and seven 2½-pounders, as well as five torpedo tubes, all of which are submerged except one.

H.I.J.M.S. "Takasago" is a protected cruiser launched from the Elswick shipyard in 1897. Her dimensions are: Length 360 feet, beam 45 feet 6 inches and draught 17 feet; displacement 4,160 tons and indicated horse power 15,500, giving a speed of 23 knots. Her armament consists of ten 4.7-inch, twelve 12-pounders and six 2½-pounders, as well as five torpedo tubes.

There will be four first class battleships at Spithead on August 16, representing Germany, Russia, the United States and Greece. The newest and probably the most formidable of the three is the Russian first class battleship "Pobieda" ("Victory"). She was built in the Baltic yard, St. Petersburg, and was launched on January 24, 1900. Her dimensions are: Length 401 feet 3 inches, beam 71 feet 6 inches, and draught 25 feet 3 inches; displacement 12,674 tons, indicated horse power 14,500, and speed 18 knots. She is driven through the water by three propellers. She carries four 10-inch, eleven 6-inch quick-firing, sixteen 3-inch, ten 1.8-inch, seventeen 1.4-inch and two light guns, also six torpedo tubes. The "Pobieda" will fly the flag of Rear-Admiral Kasherininoff.

The "Kaiser Friedrich III." is a first class battleship whose four sisters are the "Kaiser Barbarossa," "Kaiser Wilhelm II.," "Kaiser Wilhelm der Grosse" and "Kaiser Karl der Grosse."

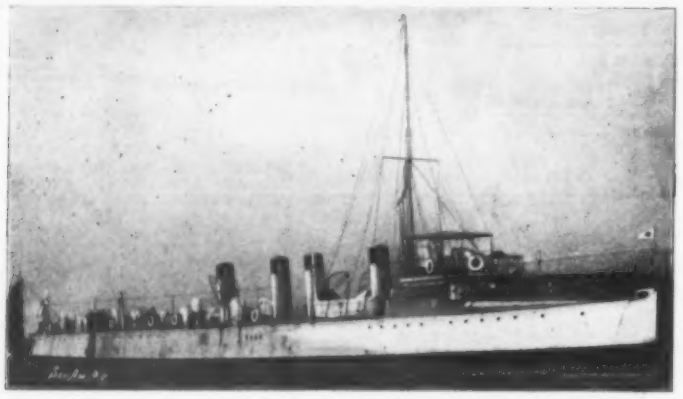
The "Kaiser Friedrich III." was built at Wilhelmshaven and was launched in 1900. Her dimensions are: Length 377 feet 4 inches, beam 66 feet 10 inches, draught 25 feet 6 inches; displacement 11,130 tons, indicated horse power 13,000 and speed 18 knots by three propellers. Her armament consists of four 9.4-inch, eighteen 5.9-inch, twelve 3.3-inch, twelve 1.4-inch and eight machine guns; she carries six torpedo tubes, five of which are submerged. She will fly the flag of Admiral Prince Henry of Prussia.

The United States had apparently resolved upon making a considerable display at the Coronation Review with a squadron including the "Illinois," "Cincinnati," "Chicago," "Atlanta," "San Francisco" and "Nashville."

The "Illinois" is a first class battleship built at Newport News and launched in 1898. Her dimensions are: Length 368 feet, beam 72 feet 3 inches, draught 24 feet 9 inches displacement 11,565 tons, indicated horse power 10,000 and speed 16 knots. She carries the following armament: Four 13-inch, fourteen 6-inch quick-fire, sixteen 6-pounders, six 1-pounders, four machine and two light guns; also four torpedo tubes.

Of armored cruisers there were five present for the Review. France sent the "Montcalm," which flew the flag of Rear-Admiral Richard; Italy the "Carlo Alberto," which flew the flag of Admiral Mirabello; Spain was represented by the "Emperador Carlos V." (Commodore Felix Battereche); Denmark by the "Herluf Trolle" (Captain Scheller), while Japan, as has been mentioned above, sent the "Asama."

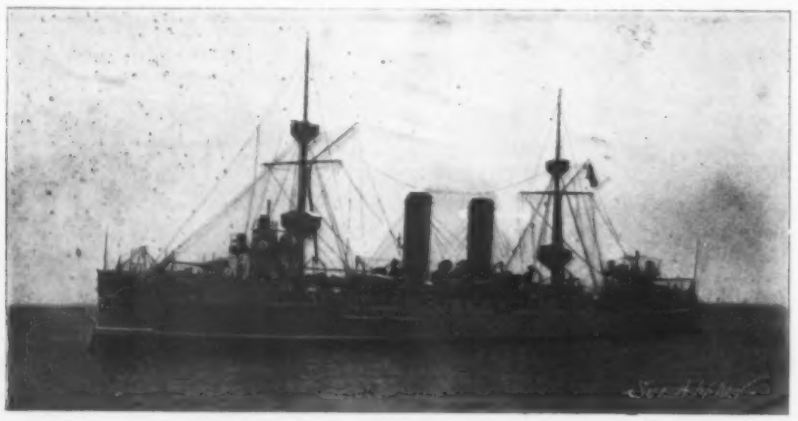
The "Montcalm" was built at La Seque and launched in 1900. She has a length of 452 feet 9 inches, beam 63 feet 8 inches and draught 24 feet 7 inches; the displace-



JAPAN. TORPEDO-BOAT DESTROYER "ASASHIO." DISPLACEMENT, 300 TONS. SPEED 31 KNOTS.

JAPAN. PROTECTED CRUISER "TAKASAGO." DISPLACEMENT, 4,160 TONS. SPEED, 23 KNOTS.

Country.	Launched.	Name of Vessel.	Length. Ft.	Length. In.	Beam. Ft.	Beam. In.	Draught. Ft.	Draught. In.	Displacement. Tons.	Indicated Horse Power.	Speed. Knots.	Armament.	Torpedo Tubes.
France	1900	Montcalm.	425	6	63	8	24	7	9,517	10,600	21	Two 7-in., 8 6·4-in., 4 3.9-in., 16 1.8-in., 6 1.4-in.	3
Germany	1900	Kaiser Friedrich III.	377	4	66	10	25	6	11,130	13,000	18	Four 9.4-in., 18 5.9-in., 12 3.3-in., 12 1.4-in., 8 m.	6
Russia	1900	Pobieda.	401	3	71	6	25	3	12,674	14,500	18	Four 1"-in., 11 6-in., 16 3-in., 10 1.8-in. 17 1.4-in., 2 l. g.	6
Italy	1896	Carlo Alberto.	325		70		22	11	6,300	13,200	19.2	Twelve 6-in., 6 4.7-in., 2 2.9-in., 10 2.9-in., 10 1.4-in., 2 m	6
Spain	1895	Emperador Carlos V.	380		67		25		9,235	18,500	20	Two 11-in., 8 5.5-in., 4 3.9-in., 2 2.7-in., 4 2.2-in., 6 m.	6
Portugal	1898	Don Carlos I.	300		46	6	17	6	4,100	12,500	22	Four 5.9-in., 8 4.7-in., 12 3-pdr., 6 1-pdr., 4 m.	5
Denmark	1899	Herlut Trolle.	271		50		16	5	3,470	4,300	16	Two 9.4-in., 4 5.9-in., 10 2.2-in., 8 smaller guns.	
Norway	1900	Norge.	290		50	6	16	6	3,847	4,500	16.5	Two 8.2-in., 6 5.9-in., 8 12-pdr., 6 3-pdr.	2
Sweden	1896	Oden.	378	3	48	7	17	6	3,500	5,300	16.5	Two 9.8-in., 4 4.7-in., 10 2 2-in., 4 machine guns	1
Greece	1890	Psara.	334	6	51	10	23	8	4,885	7,000	17	Three 10.6-in., 5 5.9-in., 1 3.9-in., 8 2.5-in., 4 1.8-in., 12 1.4-in.	3
Netherlands	1896	Holland.	294		48	6	17	8	3,900	10,000	19 6	Two 5.9-in., 6 4.7-in., 4 2.9-in., 8 1.4-in., 4 m.	4
United States	1898	Illinois.	368		72	3	24	9	11,565	10,000	16	Four 13-in., 14 6-in., 16 6-pdr., 6 1-pdr., 4 m., 2 l. g.	4
Chili	1901	Chacabuco.	360		46		18		4,500	15,750	23	Two 8-in., 10 4.7-in., 16 1.8-in., 2 m., 1 l.	3
Argentine Republic	1897	Presidente Sarmiento.	....		....		....		2,750	2,400	13	Nineteen guns.	3
Japan	....	Asama.	408		67		24	3	9,850	19,000	22.1	Four 8-in., 14 6-in., 12 12 pdr., 7 3⅛-pdr.	5
	....	Takasago.	360		46	6	17		4,160	15,500	23	Two 8-in., 10 4.7-in., 12 12-pdr., 6 3⅛-pdr.	5
	....	Asashio.	....		....		....		....	....	....	....	....
Austria Hungary	....	Szigetvar.	310	10	30	6	14	2	2,350	7,800	30	Eight 4.7-in., 12 1.8-in.	1



PORTUGAL. PROTECTED CRUISER "DON CARLOS I." DISPLACEMENT, 4,100 TONS. SPEED. 22 KNOTS.

WARSHIPS AT SPITHEAD FOR THE CORONATION NAVAL REVIEW.

ment is 9,517 tons, indicated horse power 19,600 and speed 21 knots. She carries two 7.6-inch, eight 6.4-inch, four 3.9-inch, sixteen 1.8-inch and six 1.4-inch guns; also two submerged torpedo tubes.

The "Carlo Alberto" was built at Spezia and launched in 1896. Her dimensions are: Length 325 feet, beam 59 feet, draught 22 feet 11 inches; displacement 6,500 feet, indicated horse power 13,220, and speed 19.2 knots. Her armor is made up of twelve 6-inch quick-fire, six 4.7-inch, two 2.9-inch, ten 2.2-inch, ten 1.4-inch and two machine guns; three torpedo tubes are carried.

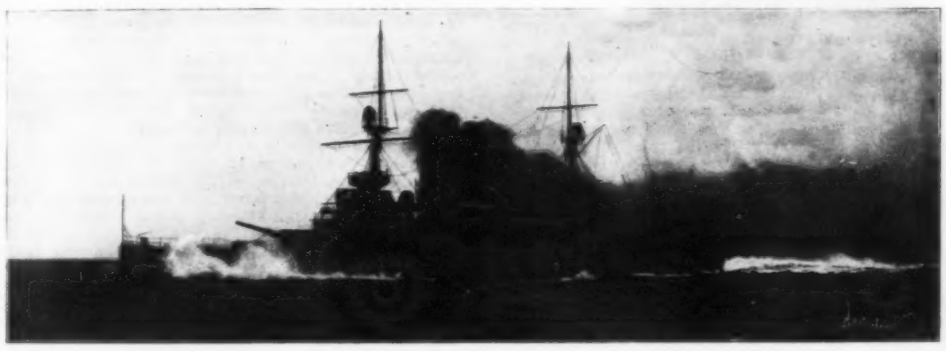
The "Emperador Carlos V." was built at Cadiz (Via Murquia) and launched in 1895. She has a length of 380 feet, beam 67 feet and draught 25 feet; her displacement is 9235 tons, initial horse power 18,500 and speed 20 knots. Her armament consists of two 11-inch, eight 5.5-inch quick-fire, four 3.9-inch, two 2.7-inch, four 2.2-inch and six machine guns and six torpedo tubes.

The "Herluf Trolle" was built at Copenhagen and launched in 1899. Her length is 271 feet, beam 50 feet, draught 16 feet 2 inches; displacement 3,470 tons, indicated horse power 4,200 and speed 16 knots. She carries two 9.4-inch, four 4.9-inch quick-fire, ten 2.2-inch and eight smaller weapons.

Norway and Sweden each sent as their representatives an armored coast defence turret ship. The "Norge" was built at Elswick and launched in 1900. She has a length of 290 feet, beam 50 feet 6 inches and draught 16 feet 6 inches; displacement 3,847 tons, indicated horse power 4,500 and speed 16 knots. She carries two 8.2-inch, six 5.9-inch quick-fire, eight 12-pounders, six 3-pounders and two submerged torpedo tubes.

The "Oden," which flew the flag of Vice-Admiral Klistberg, was built at Stockholm and launched in 1876. She is 278 feet 3 inches long, beam 48 feet 7 inches and draught 17 feet 6 inches; displacement 3,500 tons, indicated horse power 5,330 and speed 16.5 knots. She is armed with two 9.8-inch, four 4.7-inch quick-fire, ten 2.2-inch and four machine guns; she carries one torpedo tube.

To the Diamond Jubilee Naval Review of 1897 the Argentine Republic sent no vessel, but this year she was represented by the "Presidente Sarmiento," a training ship of 2,950 tons.



NORWAY. THE COAST DEFENCE BATTLESHIP "NORGE." DISPLACEMENT, 3,847 TONS. SPEED, 16 KNOTS.

WARSHIPS AT SPITHEAD FOR THE CORONATION NAVAL REVIEW.

BLACK WALNUT.

THE best black walnut in the United States is found in Indiana. Forty years ago, says the Terra Haute Gazette, there could be found in this State a crop of black walnut unequaled in quantity and quality. Today it is not to be found in such immense trees. Neither is the number of trees by any means so large. Years ago the largest and best trees were used for fence rails and such common purposes. At that time it had no particular commercial value. Before walnut came into general use, the most of domestic furniture was of cherry. Walnut has now entirely superseded this and all other woods. Fence rails can be found to-day through Indiana that were split more than a half century ago, and they are as sound now as then, save the wear and tear. Of all hardwoods the walnut is most durable, save red cedar, and possibly in the ground, black locust would equal it.

Our walnut is comparatively gone. In isolated parts of the country, where this timber grows, there is yet some of inferior quality, but to a limited extent. But the general black walnut growing in the deep forest, in the rich lowlands, in its primitive nature, is a thing of the past. The general supply must now be gathered from the four quarters of the earth to supply a demand that requires a century for its culmination, and its culmination witnesses the astounding spectacle of the almost entire extinction of the valuable material.

Kentucky has quite a good stock of black walnut, and much that is very inferior on account of its gray color and tough, hard texture. Missouri also has some of rather an inferior quality. Western Ohio and West Virginia is poor in quality.

The whole stock of the States is not equal to a full demand for ten years to come. Furniture manufacturers do not now use it as lavishly as they did five years ago. Other woods are substituted when possible, and 1,000 feet of walnut is made to go as far again as it did a few years ago.

Chicago uses annually in her different branches of manufacture, such as house, school and office furniture, also in finishing materials, doors, moldings, counters, etc., 14,500,000 feet. Probably about half of this is bought at the mills, and does not go into the account of the dealers at all. Many of the largest manufacturers direct, or have mills or an interest in, mills in the walnut district.

Correspondence.

THE INVENTION OF THE SEWING MACHINE.

To the Editor of the SCIENTIFIC AMERICAN:

It has been truly said that no radically new invention ever comes, Minerva like, full armed from the brain of the inventor. At first imperfect steps are taken, partially accomplishing the result; after which from time to time additions and improvements are made on the original idea until it arrives at practical perfection. It is a well-established axiom with mechanics that the first machine made shows how not to make a second one. These facts apply with singular force in the development of the sewing machine, which was gradually evolved from several primary sources.

As so much unmerited credit has been given to a single inventor who never aided in perfecting or introducing the sewing machine into public use, but who obtained all his celebrity through the interested efforts of others for their own purposes, we propose to give a true exposition of the evolution of the invention from its first inception, awarding to each pioneer his just merits in its advance to practical results as a benefaction to the needle woman.

Some attempts were made in France to stitch gloves by machinery with a single-thread device; this plan failed and never became known abroad until search was made for it in litigation; it never aided in the suggestion of a modern sewing machine, and is only introduced as a preliminary symptom.

In 1834-5 Walter Hunt, of New York, made a sewing machine, in which he used a shuttle and an eye-pointed needle, employing two threads to form the stitch. Hunt was an erratic genius full of inventions; and after he succeeded in sewing, as he found no patron to bring it out, he was led off by some other device of his fertile brain and neglected to profit by his invention. In 1836 J. J. Greenough, of Boston, devised a sewing machine, but before patenting it he received an appointment as draughtsman in the Patent Office that debarred him from obtaining a patent. He superintended the restoration of patent drawings destroyed by the fire of 1836. On resigning from that office he patented his invention of a sewing machine, in which the stitch was made by double-pointed needles having the eye central, between the points; they carried the thread through its whole length, as in hand sewing. When his specification was filed it was decided that it contained a multiplicity of inventions that could not be granted in one patent. He had three devices for feeding the article to be stitched and was required to confine himself to one. Thinking he would be most likely to introduce his invention in harness making, he determined to patent his "clamp feet." This was a clamp moved automatically, in which the article was clamped as in harness work. This would sew seams of limited length in a straight line, and he named his device, patented February 1, 1842, a "straight seam sewing machine." His other feeds that he had to omit were the "wheel feed" (afterward adopted by Singer), which he had to strike out of his specification; but he noted in the margin that he reserved this for another patent. The wheel fed the article to be sewed for a seam of unlimited length, either in a straight line or curved in any direction. A third mode devised by him was what is known as the "four-motion feed," in which the goods were to be moved by a vibrating foot, which produced the same results as the wheel feed. Like Walter Hunt he failed to enlist anyone in the enterprise and, having a family to support, he was forced to abandon it for his professional duties. Subsequently, in 1850, he tried to recover the rights he was forced to abandon in his patent of February, 1842, but the law interposed a time limit as a bar to their recovery. He was thus left to the barren honor of being the first patentee of a sewing machine.

The next patentee for a sewing machine was G. R. Corliss, whose patent dated December, 1843. This machine stitched in the same way as that of Greenough, but it was never brought into use, as he found other and more profitable occupation for his brilliant talents.

In 1846 Elias Howe, Jr., obtained a patent for a sewing machine, the features of which were a curved needle with an eye in the point and a shuttle for forming the stitch like Hunt. He fed the cloth for stitching by a "baster plate," to which it was affixed by points or needles. This had the same defect as Greenough's clamp, sewing only in a straight line of limited extent. Howe, being a machinist, made his own machine, aided by a friend; but while he succeeded in sewing, his machine was not sufficiently perfect for practical use. Not succeeding in introducing it in this country, his brother took the imperfect machine to England and got an offer from a party there to employ the inventor in perfecting a machine for his use. Howe went over and, as he afterward reported, succeeded in adapting it to making stays. But he and his employer fell out, and they parted, after which he attempted but did not succeed in introducing a practical machine there.

In Parton's "History of the Sewing Machine," written to glorify Howe as its inventor, he says: "After his return from his residence in London, Elias Howe discovered, much to his surprise, that the sewing machine had become celebrated. Several ingenious mechanics had turned their attention to inventing in the same direction." This quotation, written by Howe's advocate, clearly shows that the sewing machine was not indebted to Howe for its introduction or success, any more than it was to his predecessors. Several inventors made and patented parts of sewing machines and succeeded in making them practical; while up to the time of Howe's return from England, where he had totally failed, he had not succeeded in producing a practical machine.

Those inventors and manufacturers who had patented and introduced sewing machines into use during Howe's absence from the United States had begun to reap the reward of their ingenuity and perseverance before his return. The device that made the sewing machine practical, whatever stitch was used, was the endless feed, with freedom to turn the course of stitching in any direction, which was the invention of Greenough, made long before Howe's device. This has been used in some form in every successful machine since.

Lerow and Blodget patented a sewing machine in 1849 that worked practically. Morey and Johnson also patented a single-thread machine in the same year, and sold machines made on their plan. Allen B. Wilson obtained a patent in 1850 for a double-pointed shuttle making a stitch at each vibration. Grover and Baker obtained a patent in 1851, employing two needles to make the stitch. These all used the endless feed. In August, 1851, I. M. Singer patented a sewing machine which had improvements over its predecessors in adjusting the tension of the thread. He used a wheel feed like that described by Greenough in his specification of 1841. Singer's machine, and those of Lerow and Blodget, Wheeler and Wilson and some others became popular and established the value of the sewing machine. These men had a hard battle to fight against the inertness and prejudice of the public, in which Elias Howe took no part and rendered no assistance. Subsequently the large profits realized by the successful manufacturers attracted numerous small makers into the business, which the larger concerns desired to suppress. Consequently they sought means to do so. Howe had commenced suits against parties infringing his patent; and in the vagaries of patent litigation he had gained verdicts against them. To discuss this matter here would lead us too far afield; but as this promised the most potent offensive weapon against the small manufacturers an agreement was entered into by certain prominent producers with Howe to acknowledge his claims and take a license from him on royalty which was to be exclusive, thus shutting out all their small rivals. This brought immense wealth to the monopolists and their coadjutor, Howe. When Howe's patent was about to expire the right to extend patents was vested in the Commissioner of Patents, whose *ipse dixit* was to determine whether the patentee had received a sufficient remuneration for his time, labor and expense for making and introducing his invention. It was shown on the hearing before the Commissioner that Howe had received over $600,000 above all his expenditures; a sum greater probably than was ever received from any patent up to that day. The Commissioner of Patents decided that this princely sum was not sufficient to remunerate Howe, so he extended his patent —a decision worth many millions of dollars to the licencees and to Howe, a large portion of which was to be paid for out of the hard earnings of the poor sewing women. It was generally understood that the counsel in that case had $300,000 more or less placed in his hands to obtain the extension. If so, his disbursement of it was never made public. The Commissioner, Philip F. Thomas, afterward made Secretary of War by Buchanan, did not write out the reasons for his decision in that case, as was the custom in such proceedings, and subsequently the power of the Commissioner to extend patents was repealed.

From the facts above stated the public will be able to judge how far Elias Howe is entitled to the credit of giving to the world the sewing machine.

Brookline, Mass. J. J. GREENOUGH.

THE FOUNDER OF ENGLISH YACHT RACING.

KING CHARLES II., like many of his ancestors, was devoted to the sea and an enthusiastic yachtsman. Queen Elizabeth, we are told, had a pleasure yacht, and so, we understand, had James I. But Charles II. was the earliest of our sovereigns to enjoy yachting as a sport, and we read in Pepys of his racing matches on the Thames with yachts from Holland, and also of the easy victory obtained by the latter. This, however, only seems to have added to his zest, for comment is made later concerning various craft designed and built to his orders, as well as to those of the Duke of York, his brother.

He may, therefore, in a sense be regarded as the founder of yacht racing in this country, and, pace the shade of Lord Macaulay, that among other good qualities should certainly be placed to his credit. The first yacht club that was started in the United Kingdom was the Royal Cork, in 1720, not thirty-five years after King Charles' death, and I consider that among the toasts which are annually given at meetings of the present day wet bob fraternity that of the Merry Monarch should always find an honored place.

A paper recently read at the Society of Antiquaries by the president, Viscount Dillon, on some unpublished correspondence of Charles II. and his brother James, touched on a point of some interest in these matters. Mention was made in the royal letters of a certain yacht belonging to the King called "The Fubbs."

One of the fellows of the society was able to throw

a light on this curious word. It appears to have been the favorite nickname bestowed by Charles on the Duchess of Portsmouth, and, without a doubt, his yacht with the same title was christened thus in her honor. At Greenwich, too, there still exists a well-known hostelry yclept "Fubbs' Yacht," showing what a tenacious grip the nomenclature of many old inns holds upon the otherwise almost forgotten traditions of the past.—Notes and Queries.

METER-GAGE FAIRLIE ENGINES FOR THE BURMA RAILWAY COMPANY.

THE noteworthy type of locomotive known as the double-bogie Fairlie engine has been built so seldom of late years that it will be of considerable interest to describe the most modern form which these engines have taken in the five recently delivered to the Burma Railway Company by the Vulcan Foundry, Limited, Newton-le-Willows.

The type of engine in question combines a maximum amount of adhesive weight with a minimum length of rigid wheel base, and is supported entirely on bogies in order to reduce the frictional resistances. Its chief advantage is that of being able to deal successfully with heavy loads on steeply-inclined railways on which sharp curves abound.

Before dealing with the particular engines under notice, we think it well to give some short account of the earlier "Fairlies," which may serve as a standard of comparison with the new ones. The first double-bogie Fairlie engine, the "Progress," was built by Cross & Co., of St. Helens, for a Welsh railway of 4 feet 8½ inches gage, and was first tried in steam on December 16, 1865. Each of the steam bogies of this engine had a wheel base of 5 feet, the wheels being 4 feet 6 inches diameter, and the four cylinders 15 inches in diameter by 22-inch stroke. The boiler was formed of two barrels placed back to back and united together by a single firebox, 6 feet 6 inches long by 3 feet 10 inches wide. The firehole was on one side of the engine, so that the fireman was completely separated from the driver by the intervening firebox. Each bogie pivot casting was fastened to the bottom of the boiler barrel —a distinctly objectionable feature—and to prevent the bogie pivots from having to carry the entire weight, the boiler was also supported on wrought iron brackets bolted to the end plates of the bogie frames. The firebox was supplied with guard plates to take the side thrust of the trailing wheels—a primitive arrangement, intended to reduce dangerous oscillation.

The most essential feature in the construction of Fairlie engines is the provision of a flexible pipe for supplying steam to the cylinders, such as will allow the bogie, when passing over sharp curves, to take up a position at an angle with the center line of the boiler. The original engine had a copper steam pipe coiled once round the inside of the smoke box. A slotted aperture in the bottom of the latter allowed the pipe to pass through to the steam chests, to which it was rigidly connected by ordinary flanged joints. This pipe coiled and uncoiled slightly as the bogie swiveled, and, it is needless to say, soon proved a source of much trouble, owing to the fatigue and consequent cracking of the material.

During the years 1870 to 1875 a large number of double Fairlie engines were constructed for Russia, South America and New Zealand by the three firms which became at that time identified with their manufacture—the Avonside Engine Company, the Yorkshire Engine Company and the Vulcan Foundry.

The new engines under consideration have been built for the Mandalay-Kunlon section of the Burma railways, a line which crosses the Zibingyi Ghât with a ruling gradient of 1 in 25, and having curves of 300 feet radius. The experience gained with the working of ten double-boiler Fairlie engines, built in 1880 by the Avonside Engine Company, coupled with the successful results attained on the 4-foot 8-inch gage railways of Mexico by six-coupled double-bogie engines of the Fairlie type designed by Messrs. A. M. Rendel & Co. and built by Neilson & Co., decided the same consulting engineers and the locomotive superintendent of the Burma railways, Mr. C. E. Cardew, to adopt a similar type of engine. The engines already in use in Burma were at first unsatisfactory in several respects, and required considerable modification in details, but for handling the heavy traffic over the Ghâts they showed to great advantage over the tender engines with rigid wheel base. Trouble was experienced from the breakage of the pivot castings, and the crushing of the india rubber side check springs owing to the lateral thrust.

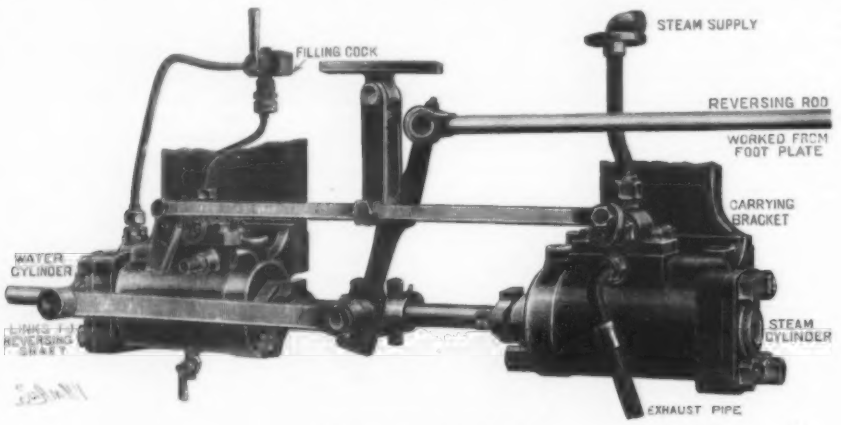
The principal feature in the design is the separation of the two boilers, so as to allow of a roomy footplate between them. One objectionable feature in former Fairlie engines was that the space at the sides of the firebox was very limited, and therefore extremely inconvenient for the driver and fireman; moreover, the heat radiating from the broadside of the firebox was almost unbearable, especially in hot climates. The separation of the boilers does not require any additional hands, as on ordinary locomotives in India the European driver is generally assisted by two native firemen.

It is obvious that there are other advantages in having separate boilers; for instance, in case of the failure of one boiler through the bursting of a tube or other causes, the other boiler and its engine are still available for their share of work.

The boilers are constructed of steel plates for a working pressure of 160 pounds per square inch, and have Belpaire fireboxes. The weight of the engines had to be rigidly confined within certain limits, and to obtain sufficient heating surface, with this end in view, each firebox is supplied with thirty-two "Drummond" cross water tubes. The roofs of the copper fireboxes are sloped toward the footplate, to allow for the gradients. The barrels are telescopic, the outside diameter at the smokebox ends being 3 feet 7⅛ inches. The tubes are inclined 1 inch. The fireholes are placed near the corner, so that the firemen do not interfere with the driver, who stands in the middle of the footplate. Arrangements have been provided for fitting Holden's liquid fuel apparatus at a future date, if required. The smokeboxes, of ¼-inch steel plates, are of the extended type, 4 feet 2½ inches long by 3 feet 9¾ inches diameter inside, and fitted with spark arresters.

The bogie frames are of Siemens-Martin steel plates 1 1-16 inch thick, united together by a strong steel casting, in the center of which a socket is recessed to receive the bogie pivot attached to the carrier or main frame of the engine. The bottom surface of this socket is spherical, and is carefully fitted to the bogie pivot. At the ends of each bogie four strong brackets of cast steel are provided, under which screw-jacks can be placed to lift the bogie in the event of the engine leaving the rails. When derailments of the earlier engines took place, the want of such provision for lifting them was the cause of prolonged delays on the road.

The carrier frame is also of Siemens-Martin steel in the form of a solid plate girder 1 1-16 inch thick, of ample depth in the center. It is stayed transversely at each end by the steel castings which rest upon the bogies. Each of these castings is in the form of a cradle, in which the front end of the boiler rests, and underneath, carefully turned out of the solid metal, is the pivot upon which the bogie swivels. The face of the pivot is turned spherically to a radius slightly less than that of the socket in the bogie casting. Additional transverse stays for the carrier frame are provided by two other cradle-shaped castings, upon which the boilers are supported immediately in front of each firebox. These castings also serve to relieve the bogie pivots of part of the weight of the boilers, and are connected to the back end plates of the bogie frames by a swinging arrangement, which does away with the objectionable india rubber side springs. For this purpose each casting has a vertical T-piece underneath it, which rests upon a cross-bearer piece attached at its ends by pins to two swing links, which are suspended from the end plates of the bogie frame. Between the T-piece and the cross bearer are interposed two pairs of spiral springs, the outer spring of each pair being 6 inches diameter and formed of 1-inch round steel, the inner spring being of ¾-inch steel. These springs are arranged to compress 1 inch under a load of four tons. The springs take up the vertical movement of the carrier frames, while the swing links allow of lateral movement when the engine is passing over sharp curves with much super-elevation.



REVERSING GEAR.

The engines are reversed by steam supplied to cylinders placed horizontally, the arrangement being shown herewith. It is somewhat similar to that applied to the eight wheels coupled mineral engines of the Lancashire and Yorkshire Railway, and has the advantage that the piston rod of the reversing-gear cylinder is coupled directly to the reversing shaft lever without the intervention of the large number of pins and joints, which would be necessary in the case of Fairlie engines were the reversing performed direct from the footplate. A casting, part of which projects below the bottom of the smokebox, is fixed to the latter, and forms a ball-and-socket joint with one end of the 3½-inch steam pipe. A similar joint, to receive the other end of the pipe, is made in another casting attached to the bogie frames. The length of pipe between the two castings has a gland expansion joint to enable one end of the pipe to slide freely in the other. Another expansion pipe returns from the last-mentioned casting toward the cylinders, the gland being formed in the lower portion of the casting. The front end of this pipe is flanged to form the connection with a "breeches" pipe, which conveys the steam to the steam chests of the two cylinders.

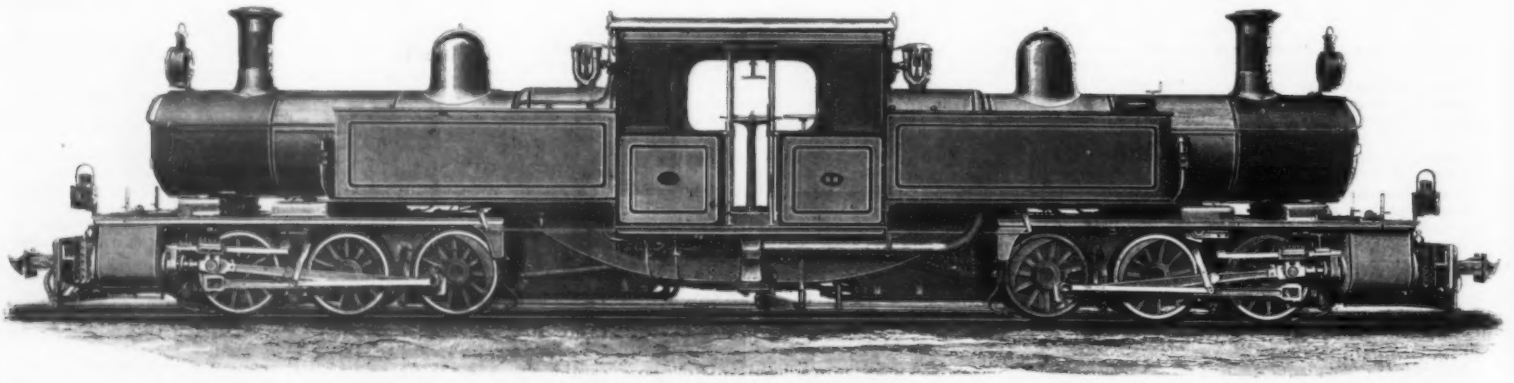
The exhaust pipe is 4½ inches in diameter, in one length, and inclined at an angle of about 45 degrees. One end issues from a casting connected to the cylinder exhaust, and the other end passes into the upper portion of the casting attached to the smokebox. Both ends of the pipe form ball and socket joints of a special design in the two castings. The slide valves are balanced. Steel castings are used very largely in the construction of these engines; in addition to the bogie centers and cradles already mentioned, the wheels, motion-plates, frame stays and brackets are of this material.

The tires of the middle pairs of wheels are without flanges. The arrangements on the footplate are novel and very ingenious. The two regulator handles are in the middle of the cab, suspended from a shaft placed lengthwise immediately under the roof. The ends of this shaft are connected to the regulator spindles by means of a system of levers. The two handles are coupled together by means of a short bolt and distance-piece, so that one movement actuates both and admits steam to the two engines simultaneously. The bolt can be removed and steam admitted to each engine separately when necessary.

The handle for the steam reversing gear works in a vertical iron pillar in the center of the footplate. To this pillar are attached two quadrants, the handle being pivoted on its center. The levers connecting it to the cylinder of the steam gear are so arranged that both engines are reversed simultaneously. The vertical shaft attached to the above handle inside the pillar is hollow, and contains the spindle to which are attached the levers actuating all the cylinder cocks, which are opened and closed by turning a similar but smaller handle placed immediately above the other. The other fittings on the footplate include a small hand pump for supplying oil to the regulator valves, arrangements for lubricating the steam brake cylinder and also Hulburd's patent water level gage cocks.

Efficient brake power is provided by the combined steam and vacuum brakes, the steam brake acting upon the engine and the vacuum brake on the train. The piston of the steam cylinder is connected to a lever, which actuates the brake rods on both engines, provision being also made for working the brakes by hand.

The engines are also fitted with the Le Chatelier



METER-GAGE FAIRLIE ENGINE FOR BURMA RAILWAY.

counter-pressure brake for regulating the speed when descending steep inclines, and with the Gresham and Craven steam sanding apparatus. The coal bunkers are arranged on the left of each engine, looking toward the chimney, the water tanks being placed on the opposite sides. All Fairlie engines in Burma are supplied with tenders, coupled to one end, as the capacity of the engine tanks is not sufficient to enable the engines to run the longer distances. The engine tanks are provided with a well, placed under the footplate at a level sufficiently low to enable them to be filled from the tender when the engine is standing on the steepest gradients. The injectors take water from the bottom of this well. The engine tanks are used only when the tender is disconnected for shunting purposes, so that special provision has to be made for severing the water pipes between them and the tender. To effect this, the ends of the well are fitted with cocks, to which are attached the connecting water pipes, the latter having "instant grip" couplings at both ends of the engine. The cocks can be closed, and the tenders immediately disconnected. At the same time a valve is opened, which connects the well with the side tanks of the engine. The whole operation can be carried out on one side in a few moments.

The details of these engines have been worked out by the builders, the Vulcan Foundry, Limited, from the designs submitted by Sir A. M. Rendel & Co., the consulting engineers to the Burma Railway Company, and Mr. C. E. Cardew, M. Inst. C. E., the locomotive superintendent, and have been constructed under the supervision of their chief inspector, Mr. S. B. Tritton. They have been tried in steam at the builders' works as far as possible under working conditions over curves of 300 feet radius with most satisfactory results.

Five of these engines have been built, of which the following are the principal dimensions:

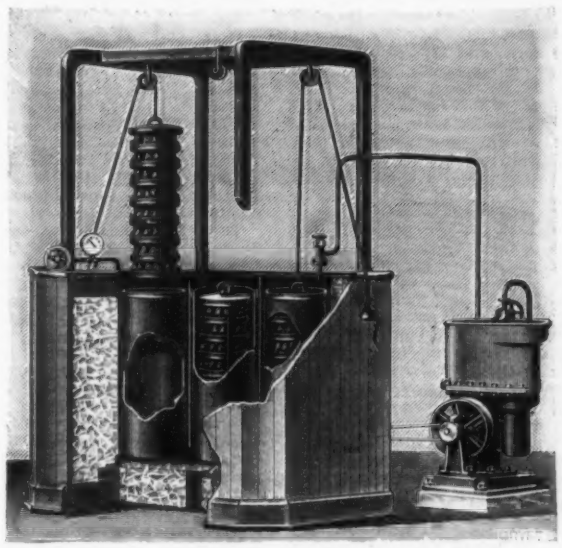
Diameter of cylinders	14 in.
Length of stroke	20 in.
Center of cylinder to center of driving axle	11 ft
Diameter of wheels	3 ft. 3 in.
Center of leading to center of middle wheels	8 ft. 9½ in.
Center of middle to center of driving wheels	3 ft. 9½ in.
Rigid wheel base	7 ft. 7 in.
Center to center of bogies	26 ft. 8½ in.
Total wheel base	35 ft. 7½ in.
Width between carrier frames	3 ft. 11 in.
Width between bogie frames	2 ft. 8½ in.
Diameter of boilers inside largest rings	3 ft. 6¼ in.
Length of boiler barrels	8 ft. 9 in.
Length of fire-box casing outside (bottom)	4 ft. 7½ in.
Width of fire-box casing outside	3 ft. 10 in.
Center of boiler from rails	6 ft. 1½ in.
Number of flue tubes	304 "
Diameter of flue tubes	1⅝ in.
Heating surface—	
Flue tubes	1,132 sq. ft.
Water tubes	128 "
Fire-boxes	138 "
Total	1,398 "
Area of fire-grates	26 "
Total capacity of tanks	500 gals.
Total capacity of bunkers	2½ tons
Tractive force at 90 per cent of boiler pressure	28,947 lbs.
Weight of engine in working order	60 tons

The steel axles and Yorkshire iron have been supplied by Taylor Brothers, of Leeds. The tires are of Vickers' "Australia" brand.

The tenders for these engines have been made at the railway company's shops in Burma, and have a capacity of 3,000 gallons of water and 3 tons of coal.

A CONCRETE FACTORY BUILDING.

A FACTORY building, five stories high and occupying a site of 50 feet by 25 feet, has recently been completed in Jersey City, having the foundations, walls, floor beams, girders, and roof made entirely of armored concrete. The building contains about 500 yards of Portland cement concrete, and 12 tons of twisted steel rods, varying from ¼ inch to 1 inch square. The ground floor is supported about 5 feet above ground-level on foundation walls with expanded bases of sufficient area to reduce the pressure on the unstable soil to 2,000 pounds per square foot. All the floors are designed for loads of 250 pounds per square foot, and each consists of a continuous concrete slab, 4 inches thick in the case of the ground floor, and 2½ inches thick in all other floors, finished with a ½-inch granolithic surface. The floor joists on the ground floor are of steel-concrete, 26 inches from center to center, and measure 4 inches wide by 20 inches deep. They are flush with and supported by beams of similar material and depth, but 6 inches wide, each made in two lengths, so as to provide for expansion. On the upper floors the joists and beams are of lighter construction, and flanges are molded on the lower edges of the joists to carry wooden beams, to which hangers for shafting may readily be secured. Twisted steel rods are carried through all concrete work, and the lower portions of the joists and beams are strongly reinforced in this manner for withstanding tensile stress. The steel rods are joined together by means of sleeve-nuts, and so continuity of support is secured. This factory building is interesting as an example of concrete construction, but the adoption of concrete joists and beams seem to offer little advantage, while the great depth of such members would frequently be a distinct drawback.—The Builder.



CORBLIN AND DOUANE'S FRIGORIFIC APPARATUS.

NEW PROCESS OF PRESERVING FRUIT.

THE exhibit of industrially preserved fruit at the last Exposition of Chrysanthemums at Paris was not the least of the attractions to be found there. The question of the preservation of fruit by cold is not new, since it has been solved in the United States, where it was first studied simultaneously with that of the preservation of meat, butter, eggs and other food products. Cold storage was adopted especially for the carriage of such products in cars and in chambers installed aboard of ships.

But, in addition to the fact that the processes employed up to the present are not perfect as regards fruits, they have the drawback of necessitating costly installations that are within reach only of large establishments and that cannot be put to profit by those who desire to preserve small quantities of fruits.

Let us recall the conditions that have to be fulfilled by apparatus designed to preserve fruit by cold. In the first place, the space in which the fruit is placed must be very limited, so that the volume of air that surrounds the latter shall be very feeble. A renewal of the air must be avoided. The fruit must be protected against the light, and the necessity of entering the chamber in which it is preserved must be done away with. Finally, the temperature must be kept as uniform as possible, so as to prevent the expansion and contraction of the liquids contained in the fruit through a change in their density, which varies with the temperature and, in time, causes a disintegration of the pulp and thus renders the fruit mealy.

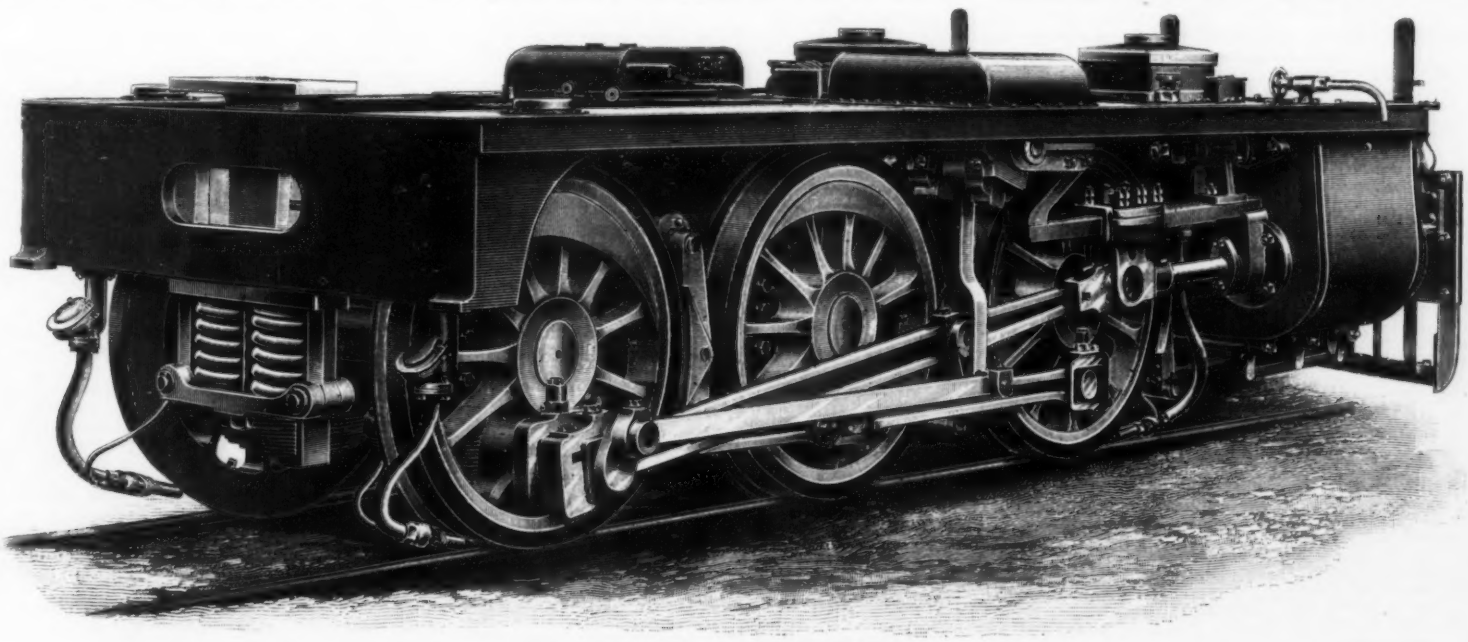
Cold chambers do not permit of sufficiently realizing all such desiderata. Being given the necessity of leaving passages for the moving about of those in charge of the various manipulations, the volume of air that surrounds the fruit is relatively large. The entrances and exits of the workmen renew the air in contact with the fruit and cause a deposit of humidity due to the residuary aqueous vapor of respiration; and, finally, the workmen are obliged to operate in a cold atmosphere.

A uniform temperature can be obtained only with apparatus that are operated day and night, or with apparatus which, placed in the chambers, store up the necessary cold in the form of frigorific brine, ice, or a freezing mixture in sufficient quantity to counteract the effects of stoppages of the apparatus. Even with such arrangements, it is difficult to keep the temperature uniform, since the latter is at the mercy of a series of external influences that it would take too long to examine in a single article.

Upon the whole, there are many causes that are absolutely inimical to the preservation of the aspect and flavor of fruits, and that bring about their desiccation and the disappearance of their fragrance. Impressed by these facts, MM. Douane and Corblin studied the possibility of utilizing for fruit the apparatus of their invention which had given so decisive results in the preservation of butter.

M. Loiseau, president of the Society of Horticulture of Montreuil, and a few fruit culturists aided these inventors with their co-operation and furnished the fruit necessary for the experiments. These latter, upon the advice of M. Loiseau, were conducted upon a very large scale, since 800 peaches independently of other fruits were placed in the apparatus. M. Loiseau, in fact, was of the opinion that the experiments ought to be made upon the peach especially, since this is a delicate fruit very difficult of preservation, and, if the results were successful with it, it was certain that other fruits could be preserved equally well.

In this apparatus, the arrangement of which is shown in the accompanying figure, recourse is had to a direct cooling obtained by substituting for the cold air chamber a refrigeratory containing receptacles in which the products are placed without order, or in baskets or crates, or upon shelves. These receptacles are surrounded with brine cooled by any sort of frigorific apparatus, or by ice or a freezing mixture. In this way the removal of the calories is not effected through a mass of air, but solely through the metallic walls of the receptacles, with the interposition, at the most, of a thin stratum of air for separating the



A TRUCK OF THE FAIRLIE ENGINE.

products from the walls when there is not a perfect contact between the two.

The fruit is introduced into the receptacles through the upper part of the refrigeratory by means of a lift varying with the dimensions of the installation. The cold air, in consequence of its greater density, tends to collect at the bottom and thus prevents the entrance of the external air during the charging and discharging. The maneuvering is always very rapid, since the receptacles are provided with a series of superposed shelves which are introduced and removed with their entire contents. Except at the time at which the fruit is introduced and renewed, each receptacle, as well as the refrigeratory as a whole, is kept hermetically closed. The form and size of the receptacles, as well as of the refrigeratory itself, vary according to the nature of the products to be preserved by cold and the size of the installation. The cylindrical form of the receptacles is explainable by the fact that the apparatus was constructed for the preservation of rolls of butter, although it had to be modified internally for the reception of a larger number of fruits.

The peaches used in the experiments were gathered on the 9th and 20th of September and placed in the apparatus on the following day. Those presented at the meeting of the National Society of Horticulture on the 28th of November had remained in the apparatus for eighty days. They were tasted and found to be very good and very fragrant.

In order to ascertain how the fruits behaved in the apparatus, some damaged peaches were introduced into the apparatus along with the perfect ones. At the end of a month these were still intact, and it was only beginning with this period that they began to get rotten. As for the others, they remained absolutely perfect. Moreover, while freshly gathered peaches have to be consumed by the end of two or three days, those that have been kept at a low temperature are not so apt to spoil so rapidly when exposed to the air, and may be preserved for a dozen days afterward. In order to give an idea of the advantage of preserving fruits, which, at the time of ripening, have only a relative value, we may state that some of the peaches that were worth about two cents apiece at the time at which they were put in the apparatus brought twenty-five cents each at the Exposition of Chrysanthemums, while others were offered at a much higher price.

With this apparatus peaches may be preserved for three months, and this would permit of their being eaten in February, provided late varieties were selected. It is preferable to gather the fruit that is to be preserved a short time before its maturity.

As a result of the experiments it has been found that the fruits may be wrapped up or left exposed just as may be desired. When they are removed from the apparatus, abrupt transitions from cold to heat must be avoided, since otherwise they will become fissured and lose their value.

The Corblin and Douane apparatus, which is new, since it was patented in 1901, therefore offers manifold advantages, which may be recapitulated as follows: By localizing the cold we succeeded in obtaining smaller and more cheaply operated apparatus, requiring much less motive power for a given number of fruits than for the same number stored in a refrigerating chamber. With the great volume of the ice, frigorific brine or freezing mixture surrounding the receptacles, we obtain a uniformity of temperature that could not be otherwise maintained. In September last it sufficed to operate three hours out of twenty-four, with one-horse power, with an apparatus containing 8,000 fruits, and despite the heat, there was a variation of but one degree.—For the above particulars and the illustration we are indebted to La Nature.

PERFUMES: THEIR ANTIQUITY AND USES, WITH FORMULÆ.*

By GRAHAM BOTT.

THE employment of spices and dried flowers as perfumes is of very ancient origin, and probably their use as such dates back from the very earliest period of the existence of mankind. The art of extracting and fixing the evanescent molecules of fragrant odors emitted from aromatic and sweet-smelling substances is of more recent origin, and we are indebted to the enterprise and ingenuity of the modern chemist for those delicate odors which he in his laboratory is able to call forth by the union of certain elements, and which resemble and almost rival the old-time perfumes distilled from flowers. The perfume—considered in its more extended sense—of plants usually consists of the essential oil or gum resin contained in their stems, leaves, flowers, seeds, etc.; these are always agreeable and aromatic. The synthetical perfumes of the chemist are more often derived from substances which cannot be described as fragrant, such material as the refuse of gasworks and the drainage of manure heaps being laid under contribution for the exercise of his skill. This fact excites astonishment when first expounded, but on thoughtful consideration, amazement gradually glides into wonder, and then wonder merges into admiration, until at last we arrive at the dead level of every-day thoughts. Science, after all, only accomplishes by known methods that which is performed by plants and animals by a process which is but imperfectly understood. Thus, the scientific chemist employs the same substances as the plants—the philosopher reveals his process, nature refuses to divulge her secret, and it becomes a question which is the more wonderful of the two.

The word perfume has a very wide signification, and is applied to all pleasant odors. Originally it had a more limited meaning. It is derived from the words *per fumum*, which signifies any sweet-smelling substance given off with the smoke. Thus, myrrh of the Sacred Oracles—which is considered to be the produce of *Amyris commiphora*, commonly termed Indian bdellium, or false myrrh—was used, mixed with other gum resins and with spices, as incense nearly 3,700 years ago; and we find Moses referring to it in Genesis xxxvii. 25, where he tells us that a company of Ishmaelites came from Gilead with their camels, bearing *spicery* and *balm* and *myrrh*, going to carry it down to Egypt. It is peculiarly interesting to note the derivation of the word myrrh as fabulously related by the ancient poets, who inform us that the plant received its name from Myrrha, the daughter of Cinyras, King of Cyprus, who became enamored with her own father, and, after having accomplished her desire, fled to Arabia, where she was transformed into a tree, which tree still continues to be known by her name.

At a much later period mention is made of the Queen of Sheba giving abundance of spices and the wood of almug trees to Solomon. Although the almug tree is unconnected with the subject under consideration, it may interest the curious to point out that it is thought by some that this tree is a species of ebony, or Brazil-wood tree; others consider that the red sandal-wood tree of India, *Pterocarpus santalinus*, Linn. (N.O. Leguminosæ), was designated by that name. Probably the latter supposition is correct, as the wood is close-grained, hard, and of a fine red color, and thus peculiarly adapted for the uses to which it was put—such as the formation of pillars for the temples, and also for inlaying of harps and other stringed musical instruments used by the Hebrews.

The white sandal-wood, *Santalum album*, Linn. (N.O. Santalaceæ), was and is, highly valued on account of its fragrance, and the Chinese at the present day burn it in their temples in honor of their gods. And so, throughout the ancient Hebrew writings, we find reference being constantly made to the employment of odoriferous substances in some form or other, frequently under the term *spicery*. These substances were not always employed for the sake of their sweet-smelling properties alone; they had other very definite uses, and the ancients readily recognized this. Thus the Hebrews seasoned their meat with spice; with it they imparted what flavor they chose to their wines, perfumed their women, fumigated their beds and their clothes, and with it they also embalmed their dead bodies. From this it will be seen that spicery in those days embraced any aromatic substance.

The fragrant gums stacte, onycha (a species of wing shell which when burnt gives off an aromatic odor somewhat resembling the odor of musk), galbanum, with frankincense, were ingredients of the sacred perfume of the Jews, and their holy ointment was composed of calamus, myrhh, cinnamon, and pinguis. These are believed to be the most ancient formulæ for odorous compounds on record. Pliny mentions *pot-pourri*, and refers to stacte as a spontaneous liquid exudation of the myrhh tree. Musk is noticed by Aëtius, a Greek who flourished during the end of the fifth century, and who held the post of physician to the Court of Constantinople. This animal secretion is not referred to by any earlier author. It is said that the *pot-pourri* Frangipanni was invented by Mutio Frangpanni, one of the earliest of the Roman nobles and a renowned alchemist, the plant whose scent he wished to imitate being known to botanists as *Plumeria alba*. The ancient Egyptians buried with their dead aromatic seeds, leaves and plants, and filled vessels with a mixture of odoriferous gums and spices, and interred these also with the remains of their kindred. One of these vases is shown to tourists at the old military fortress of Alnwick, in Northumberlandshire, and is said to have been taken from an Egyptian catacomb more than 3,000 years ago. It still evolves a pleasant odor, and thus affords evidence of the skill with which they prepared their perfumes and the remarkable persistence of their fragrance.

Frankincense and myrrh were the oblations of the ancients in their temples, and curious and strange though it may appear, this archaic custom is still observed by the Sovereign of England, and is presented annually on the Feast of the Epiphany in the Chapel Royal in London. King Edward VII.'s offering of gold, frankincense, and myrrh was *symbolically* presented for the first time in January, 1901.

These facts establish the antiquity of perfumes, and serve to illustrate the extensive and manifold uses of aromatic and sweet-scented substances employed in former ages.

Considered from a hygienic point of view perfumes are of much value; they not only mask offensive odors, but operate as true antiseptics and deodorants. A number of persons at one time were seized with unbounded faith in the virtues of perfumes in this respect. Thus, according to tradition, at the time a certain dreadful contagious disease was ravaging a Continental city, four men, under the pretence of rendering assistance to the sufferers, plundered the dead, and took advantage of the helpless condition of the sick. These ruffians did not contract the disease. They were ultimately caught and condemned to death. One alone escaped the extreme penalty by confessing the means employed by which he and his companions avoided contagion. This proved to be a certain perfume, the composition of which he disclosed, and it was known afterward as the "Four Thieves' Bouquet."

It is not intended to present an exhaustive account of the processes employed in the preparation of perfumes, many of which can only be profitably carried out on a large scale. Simple formulæ will be given, such as may be compounded in any pharmacy without the trouble of making numerous extracts, tinctures and spirits *et hoc genus omne*. Under each formula a few interesting particulars will be offered with reference to any ingredient entering into such formula.

GENERAL DIRECTIONS.

(1) It is absolutely essential for obtaining the best results to see that all vessels are perfectly clean.

(2) Always employ alcohol, 90 per cent, deodorized by means of charcoal.

(3) When grain musk is used as an ingredient in liquid perfumes, first rub down with pumice stone, then digest in a little *hot* water for two or three hours, finally add to alcohol. The addition of two or three minims of acetic acid will improve the odor and also prevent accumulation of NH_3. Civet and ambergris should also be thoroughly rubbed down with some coarse powder and transferred directly to alcohol.

(4) Seeds, pods, bark rhizomes, etc., should be cut up in small pieces or powdered.

(5) Perfumes improve by storing. It is a good plan to tie over the mouth of the containing vessel some fairly thick porous material, and to allow to stand for a week or two in a cool place, instead of corking at once.

(6) It is perhaps unnecessary to add that as large a quantity as possible should be decanted, and then filter the residue. This obviously prevents loss by evaporation. Talc or kieselguhr (amorphous SiO_2) are perhaps the best substances to add to filter to render liquid perfumes bright and clear. This is more especially necessary in the case of aromatic vinegars.

(7) The word *otto* implies the essential oil.

ORRIS TINCTURE.

Powdered orris	8 ounces
Alcohol (90 per cent)	20 fl. ounces

Macerate seven days, filter, and percolate residue with alcohol, sufficient to produce 20 ounces of tincture.

THE KING'S BOUQUET.

Clove otto	10 minims
Bergamot otto	60 minims
Tonquin grain musk	1 grain
Coumarin	10 grains
Concentrated rose water (1 to 40)	1 fl. ounce
Benzoin tincture	1½ fl. drachm
Orris rhizome tincture	2 fl. ounces
Civet	2 grains
Almond otto	5 minims
Alcohol (90 per cent)	8 fl. ounces

Mix and digest for one month.

Civet is an unctuous, odoriferous substance obtained from the civet cat (*Viverra civetta*, Schreber), which is a kind of weasel. It inhabits Northern Africa, and is domesticated for the sake of the perfume it affords. Another species (*Viverra zibetha*, Schreber), inhabits Northern Asia. The substance is secreted in a small sac, or pouch, placed near the posterior extremity. Civet enters as an ingredient in perfumes as a fixing agent at the same time giving a distinctive character to the product.

FRANGIPANNI BOUQUET.

Grain musk	10 grains
Sandal otto	25 minims
Rose otto	25 minims
Orange flower otto (neroli otto)	30 minims
Vetivert otto	5 minims
Powdered orris rhizome	½ ounce
Vanilla	30 grains
Alcohol (90 per cent)	10 fl. ounces

Mix and digest for one month. This is a lasting and favorite perfume.

Vetivert otto is the essential oil of the rhizome of the monocotyledonous plant *Andropogon muricatus*, Retzius; *Anatherum muricatum*, Beauv. (N. O. Graminaceæ), which is very common in Southern India and Bengal. The dried rhizome and rootlets, which are called *kus kus*, or *vittie vayr*, in the Tamool dialect, are used in India for making scented baskets and large fans. The natives also cover a framework, made of bamboo, with the rhizomes, to form, for the doors and windows, screens. These when moistened emit a sweet-scented odor, and during the hot winds are constantly watered; thus the air is kept cool, and an agreeable fragrance imparted to it. This aromatic grass (cuscus grass) is sometimes grown in hothouses, and is easily cultivated. It is propagated by seeds and by division of the fibrous rhizome.

CANANG BOUQUET.

Ylang Yiang otto	45 minims
Grain musk	3 grains
Rose otto	15 minims
Tonka beans	3
Cassie otto	5 minims
Tincture orris rhizome	1 fl. ounce
Civet	1 grain
Almond otto	½ minim
Storax tincture	3 fl. drachms
Alcohol (90 per cent)	9 fl. ounces

Mix, and digest one month. The above is a very delicious perfume.

Cassie otto is rerived from the flowers of *Acacia farnesiana*, *Mimosa farnesiana*, L. (N. O. Leguminosæ, sub-order Mimoseæ). It is a very pretty Australian acacia, and out of the many species this one is usually selected for cultivation in green-houses on account of the delicious odor of its golden-yellow blossoms, which somewhat resemble the odor of violets. The wood of this and other species of acacia is valuable by reason of its hardness and durability. It is used for making axletrees and wheels.

Cassie otto must not be confounded with cassia otto, the essential oil obtained from *Cinnamomum cassia*.

YLANG YLANG.

Ylang Ylang otto	10 minims
Neroli otto	5 minims
Rose otto	5 minims
Bergamot otto	3 minims
Grain musk	1 grain
Alcohol (90 per cent)	10 fl. ounces

Mix, and digest for a fortnight. More delicate than the preceding, but always popular.

Ylang Ylang otto is obtained from the flowers of the canang tree of the Moluccas, the alanguilan of China, *Mona odorata* (N. O. Anonaceæ). The word Ylang Ylang in the Tagal dialect signifies the "flower of flowers." Numerous other species of the various genera belonging to the Anonads produce powerful and delicious odoriferous seeds and flowers. These are much esteemed by the Malayanese women for making pomade with which they anoint their bodies. They also wreathe chaplets with the flowers for ornamenting their hair, and with them they erect triumphal arches in their marriage ceremonies.

IRIDIA.

Coumarin	10 grains
Concentrated rose water (1 to 40)	2 fl. ounces
Neroli otto	5 minims
Vanilla	1 drachm
Almond otto	5 minims
Civet	1 grain
Ambergris	3 grains
Orris rhizome (powdered)	1 drachm
Alcohol (90 per cent)	10 fl. ounces

Mix, and macerate for one month. This yields a

* Pharmaceutical Journal.

most characteristic and fragrant perfume and should enjoy a wide reputation.

Ambergris (ambra grisea, i. e., gray amber) is a morbid secretion formed in the intestines of the sperm whale, *Physeter macrocephalus*, Linn. It is found floating upon the sea, or on the coasts of Brazil and Madagascar; also on the coast of Africa and in the Atlantic Ocean. It was at one time thought to be simply indurated fæces, and some surmised it to be solidified sea-foam. Its true source was established by Dr. Swediaur (*vide* "Philosophical Trans.," vol. lxxiii.) Besides its use in perfumes ambergris is said to have been formerly employed for flavoring sauces and wines: thus Beaumont and Fletcher refer to it in the following lines:

"'Tis well, be sure
The wine be lusty, high, and full of spirit,
And amber'd all."

Considering its origin, most connoisseurs at the present time would much prefer their wines "unamber'd."

WHITE ROSE.

Rose otto	25	minims
Rose geranium otto	20	minims
Patchouly otto	5	minims
Ionone	3	minims
Jasmine otto (synthetic oil of jasmin, Schimmel)	5	minims
Alcohol (90 per cent)	10	fl. ounces

Mix. Popular, delicate, and lasting.

The word *attar* or *otto* is derived from the Turkish word *itr*, which signifies *perfume* or *odor*. One thousand roses are necessary in order to produce two minims of otto.

IRANIAN ESSENCE.

Bergamot otto	20	minims
Lavender otto	30	minims
Clove otto	20	minims
Sandal otto	30	minims
Almond otto	15	minims
Rose otto	25	minims
Grain musk	5	grains
Coumarin	10	grains
Alcohol (90 per cent)	10	fl. ounces

Mix, and macerate for a week or more. This essence is rather strong, a small quantity therefore should be made as an experiment, in case it is found to be too powerful.

JAVANESE BOUQUET.

Rose otto	15	minims
Pimento otto	20	minims
Cassia otto	3	minims
Neroli otto	3	minims
Clove otto	2	minims
Lavender otto	60	minims
Sandal otto	10	minims
Grain musk	2	grains
Alcohol (90 per cent), deodorized	10	fl. ounces
Water	1½	fl. ounces

Mix, and macerate for fourteen days.

Cassia otto is obtained from *Cinnamomum cassia*, Blume (N. O. Lauraceæ), Cinnamon Cassia; otherwise known as Chinese Cinnamon, also termed China Cassia-lignea.

The word cassia is derived from the Arabic *katsia*, which is from *katsa*, signifying to strip or tear off; this evidently refers to the manner in which the bark is collected.

Large forests of cassia trees surround the principal city of the province of Kwangse, hence the Chinese have named that city *Kwei Lin Too*, which means the City of the Forest of Cassia Trees.

PATCHOULI EXTRACT.

Patchouli otto	60	minims
Rose otto	10	minims
Limetta otto	5	minims
Alcohol (90 per cent)	10	fl. ounces

Mix.

Patchouli or Pucha-Pat otto is obtained from the Indian undershrub *Pogostemon patchouli*, Pellet. (N. O. Labiatæ). It presents a similar appearance to garden sage.

The dried leaves are sometimes mixed with tobacco to give an agreeable aroma in smoking, and the fine flavor and bouquet of some of the more expensive cigars is doubtless due to the presence of a small quantity of the otto. It is said that it is added to liquid Chinese ink in order to prevent moldiness; if this be so it does not accomplish its object. One per cent of formic acid specific grain 1.2 is more effectual.

In India the otto is freely employed by the natives for perfuming their garments, linen, shawls, etc.; to keep off insects and prevent the attack of moths.

A case illustrating the extreme sensitiveness to powerful odors which some persons exhibit is recorded in a French journal. It was that of a young lady who conceived an intense passion for patchouli. She saturated everything around her, from her linen to her furniture; and so immoderate was her use of this perfume that she quickly lost her appetite, suffered from sleeplessness, and was ultimately reduced to a state of extreme nervousness.

Formulæ for lavender water and eau de Cologne are as numerous as the leaves on Vallambrosa, and as varied as the fragments of a rainbow; but the following recipe yields a lavender water of fine fragrance, and is one of the best that can possibly be made:

LAVENDER WATER.

English lavender otto	2	fl. drachms
Bergamot otto	1	fl. drachm
Rhodium otto	5	minims
Rose otto	10	minims
Ambergris	5	grains
Tonquin grain musk	1½	grain
Alcohol 90 per cent)	10	fl. ounces

Mix, macerate for one month, and keep for two or three months before using.

LAVENDER WATER (Second Quality).

Lavender otto (Exot.)	2	fl. drachms
Rose water	2	fl. ounces
Alcohol (90 per cent)	10	fl. ounces

Mix.

EAU DE COLOGNE (First Quality).

Rosemary otto	10	minims
Orange flower otto	25	minims
Orange peel otto	20	minims
Cedrat otto	25	minims
Bergamot otto	15	minims
Clove otto	3	minims
Alcohol (90 per cent)	10	fl. ounces

Mix.

EAU DE COLOGNE (Second quality).

Rosemary otto	15	minims
Lemon otto	1	fl. drachm
Lavender otto	15	minims
Bergamot otto	30	minims
Orange peel otto	25	minims
Orange flower water	2	fl. ounces
Alcohol (90 per cent)	10	fl. ounces

Mix.

CARMELITE BALM WATER.

Melissa otto	30	minims
Sweet marjoram otto	3	minims
Cinnamon otto	10	minims
Angelica otto	3	minims
Citron otto	30	minims
Clove otto	15	minims
Coriander otto	5	minims
Nutmeg otto	5	minims
Alcohol (90 per cent)	10	fl. ounces

Mix.

Angelica otto is obtained principally from the aromatic root of *Angelica archangelica*, L. (N. O. Umbelliferæ), which is commonly cultivated for the sake of the volatile oil which it yields.

Gerarde ascribed innumerable virtues to Angelica. He praises it as an antidote, as a prophylactic, and as a universal antiseptic, thus quaintly alluding to it:

"The roote of garden angelica is a singular remedie against poison and against the plague, and all infections taken by evill and corrupt aire; if you do but take a peece of the roote, and hold it in your mouth, or chew the same between your teeth, it doth most certainly drive away the pestilentiall aire." In fact, the plant derives its name from its supposed angelic properties. And we may freely and safely concede similar virtues to the following novel preparation, much in vogue at one time, the recipe for which is given in the Accomplished Female Instructor for 1719, namely: "Angel-water, an excellent perfume, also a curious wash to beautify the skin. Prepare a glaz'd earthen pot, and put into it sixteen ounces of orange-flower water, a quarter of a pound of benjamine, two ounces of storax, half an ounce of cinnamon, and a quarter of an ounce of cloves grossly bruised, with three drachms of calamus aromaticus; set them over hot embers or a gentle fire to simmer or bubble well up; when about a fifth part is consumed, add a bladder of musk, and a few minutes after take it off and let it cool, pour it off by inclination from the settlings, and put it into a thick glass bottle; and of the dross you may make perfumed cakes, or sweet bags, to lay among clothes."

Particularly notice that a bladder of musk was to be used. Was it exceedingly cheap in those days, or were our ancestors unduly extravagant?

ORIGIN OF STARCH IN WHEAT.—EXPERIMENTAL RESEARCHES.*

WHEN the development of wheat is followed during the whole course of its vegetation, two essential properties of the grain are noticed, the nitrogenized matter and starch, formed at different periods.

The nitrogenized matter is almost completely elaborated at the time when maturation commences. Isadore Pierre ascertained that the nitrogen of the albuminoids contained in a hectare, rising to 89.95 kilogrammes on June 22, weighed only 84.59 kilogrammes on July 6, and 78.58 kilogrammes on July 28. Far from increasing during the later weeks, the nitrogenized matter diminished, without doubt in consequence of the decline of the organs containing it. At Grignon, in a moderate yield of wheat, there were 62 kilogrammes of nitrogen per hectare on June 13, and still 62 kilogrammes on July 16, and 64 kilogrammes at the time of harvesting on July 23. MM. Berthelot and André have ascertained more recently that the quantity of nitrogen in a stalk of wheat remained constant from June 2 to July 6.

If the nitrogenized matter does not increase in the entire plant, it is constantly displaced. The separate analysis of the different organs affords the opportunity of following the ascent of the nitrogen from the lower to the upper leaves; it afterward reaches the stems, and is finally concentrated in the grain. The first part of the gluten is therefore elaborated in the first period in the life of the wheat.

This is not the case with the starch. At no moment of the vegetation are amylaceous reserves discovered in the leaves of the wheat, as in those of the potato, of tobacco and of the vine. Nor are soluble reserves manifest. And yet, during the last weeks, the starch accumulates rapidly in the grain. Isadore Pierre calculated by analysis 651 kilogrammes per hectare on July 6, 1171 kilogrammes on July 15, and 1738 kilogrammes on July 25, the time of harvest. At Grignon, in a poor yield, 54 kilogrammes of starch were discovered per hectare on June 13, 1031 kilogrammes on July 16, and 1220 kilogrammes on July 23. (Dehérain, Traité de Chimie Agricole, 2d Ed., p. 335).

Since reserves of the hydrates of carbon do not exist in wheat, the starch of the grain must proceed from an elaboration of new matter. But here a difficulty is presented; in July the parts of the wheat still green are singularly restricted; the lower leaves are completely dried, and the upper leaves partially so. Scarcely any thing living remains, except the leaflets of the spikes and the top of the stems, and we have sought to ascertain whether these organs were capable of decomposing the carbonic acid of the air and forming hydrates of carbon.

In the month of July last, in a field of wheat, where the leaflets were greenish white and the top of the stems quite green for 0.09 meter below the ears, these organs were introduced separately into bell glasses, while the atmosphere was enriched with carbonic acid. After some time a little of the gas was taken from the bell glasses (which were closed with mercury, covered by a thin layer of water, to protect the chlorophyllian organs from the harmful influence of the mercurial vapors), was exposed to the sun and submitted to analysis with the following results:

DECOMPOSITION OF CARBONIC ACID BY THE EARS OR THE TOP OF THE STEMS OF WHEAT EXPOSED TO THE SUN.

No. of the experiment.	1		2		3		4	
Duration of exposure to sun.	2 hours.		3 hours.		5 hours.		7 hours.	
Centesimal composition of the gases.	Before isolation.	After isolation.	Before isolation.	After isolation.	Before isolation.	After isolation.	Before isolation.	After isolation.
Carbonic Acid	8 4	10.8	10.7	10.1	7.3	6.5	8.2	19 3
Oxygen	19 0	15 2	18.5	17 5	19 2	20.6	19.1	15.0
Nitrogen	72.6	74.0	70.8	72 4	73.9	72.4	72.4	79.7

Another experiment executed at the Museum has led to the same results; the leaflets of the spikes, at the moment of taking the samples, are therefore completely incapable of decomposing the carbonic acid of the air; and notwithstanding the intensity of the light, the phenomenon has been simply one of respiration.

The case has not been the same for the top of the stems; for these the following numbers have been obtained:

No. of the experiment.	1		2	
Duration of isolation	5 hours.		7 hours.	
Centesimal composition of the gas.	Before isolation.	After isolation.	Before isolation.	After isolation.
Carbonic Acid	10.2	0.0	7.08	1.4
Oxygen	18.1	27 9	19.50	25.0
Nitrogen	71.7	72.1	73.42	73 6

The top of the stems is therefore still incapable of decomposing carbonic acid, and it is probable that it is the stems which elaborate the starch. To assure ourselves on this point we have executed the following experiment:

The ears of a certain number of wheat stalks were cut on July 19 at 8 o'clock in the morning, and on July 20 the stems thus mutilated were collected; at the same time an equal number of stems with their ears still attached were taken out, and the ears were separated, in order to submit the stems only to analysis. These stems, whether proceeding from stalks intact or mutilated, were dried quickly; after desiccation they were reduced to powder, and the soluble carbon hydrates were analyzed on one hand; on the other those which had been dissolved by the action of malt extract of 60 deg., continued until 5 grammes of starch, placed for comparison, had been entirely converted; after the action of dilute chlorhydric acid at the boiling point on the filtered liquids, the numbers in the following table were found, which also gives the weights of the analyzed nitrogenized matter of the other samples:

CARBON HYDRATES AND NITROGENIZED MATTERS CONTAINED IN 100 PARTS OF DRY MATTER.

	Stems whose ears had been removed.	Stems whose ears were intact.
Sugar, reducing	1.33	1.40
Starch, dextrine, sugars not reducing, calculated in glucose	4.61	0.23
Nitrogenized matters	9.18	9.10

These numbers are quite instructive. They show, at first, that the nitrogenized matter contained in the top of the stems had continued there; it had not been able to dissolve and penetrate into the ear, for it was in equal quantities in the stems, whether the ears had remained uncut or not. This was also the case with the soluble carbon hydrates, but it was quite otherwise with those which had been dissolved by the diastase; these were much more abundant in the stems without the ears and in those which had preserved them. The samples having been taken from a uniform field, and having been submitted for the same time to the same light, must have elaborated the same quantity of carbon hydrates. And as the sum of these, for stems without ears, is 5.94 per cent of dry matter, and only 1.63 per cent for stems with the ears, it follows that the difference, 4.31 per cent, had passed to the ears, to concrete there in the form of starch.

It is curious to notice that the stems, performing in the wheat a function which devolves on the leaves in other plants, and which is slow, when these have lost their vitality, supplement the leaves and remain capable of elaborating the principle which contributes to the wheat its alimentary value.

This slow production of starch cannot take place unless the stems remain green; if they are dried prematurely by too strong an isolation, the yield is diminished by an insufficient formation of starch. The harvests that have been watched have furnished us an example of the influence of the seasons on the abundance of the yield and the composition of the grain.

At Grignon, after a rainy summer, we harvested in the middle of August. The slow maturation had been extremely favorable to the soil in the experimental field, which is rather dry. The amount of 60 hectoliters was realized on the best parcels, a figure not attained before or since. The grain was well constituted, containng 12.60 per cent of gluten and 77.2 per cent of starch. The next year the month of July was characterized by great heat, the maturing of the crop

*Memoir of the Académie des Sciences. From the French of Prof. P. P. Dékérain, Director, and M. C. Dupont, Assistant, of the Chaptal Museum.

was precipitated, and it was harvested three weeks earlier. The grain contained 15.3 per cent of gluten and only 61.9 per cent of starch. On calculating the quantity of nitrogenized matters in the two harvests they were found nearly equal; but in the latter year the quantity of starch produced per hectare was much less, and the weight of the yield was much affected by it.

YIELD AND COMPOSITION OF GRAIN IN THE EXPERIMENTAL FIELD AT GRIGNON PER HECTARE IN TWO SUCCESSIVE YEARS.

Weight of grain	3,445 kil.	2,922 kil.
Nitrogenized matter	459 "	447 "
Starch	2,699 "	1,898 "

If the ratio of the starch to the glutten had remained the same the harvest would have been greater, as the quantity of nitrogenized matter was somewhat in excess.

FORESTS OF THE PHILIPPINE ISLANDS.*

THE Philippine Islands lie between 4 deg. 45 min. and 21 deg. north latitude and between 116 deg. and 127 deg. east longitude, with an area of 119,542 square miles. The islands are all mountainous, some of the high peaks having an altitude close to 9,000 feet above the sea. In many of the islands the steep mountain slopes begin close to the seacoast, and to the casual observer the entire area is woodland. It has been estimated that of the 73,000,000 acres in the islands more than 6,000,000 are under cultivation. (Jordana, 1890.)

We find various estimates for the forest area by former officials.

The official geographic statistics of 1876 fix the forest area at 51,537,243 acres.

Fernando Castro estimated the forest area in 1890 at 48,112,920 acres. This includes all woodland, private as well as public land.

As one travels over the islands he is constantly struck with the large population to the square mile and the scarcity of timber close to the main traveled routes and centers of population. As one leaves the main traveled routes vast virgin forests are met with, rich in valuable hardwoods, dyewood, gums, and other products, waiting for the skill and enterprise of the American capitalist. On the island of Cebu, where we find a population of 290 to the square mile, not a merchantable stick of timber is evident, with the exception of a small tract of forest left in the northern end of this island, which forest must therefore be carefully looked after.

The island of Panay, with a population of 150 to the square mile, is almost denuded of good timber. In Luzon, where the population averages 78 to the square mile, we find no timber in the vicinity of centers of population. As we travel over the only line of railway in the islands, from Manila to Dagupan, a distance of 120 miles, we fail to see a single merchantable stick within several miles of the road. But there are tracts in various parts of Luzon where much valuable timber remains. In the northern end of the island, in Cagayan and Isabela provinces, there are at least 2,000,000 acres of valuable forest remaining. The entire east coast of Luzon, from the northern end as far south as Atimonan, comprising several million acres, is practically a virgin forest. In northwestern Luzon very little merchantable timber is left, with the exception of the slopes above 3,000 feet, where we find a species of pine (*Pinus insularis*) flourishing, all ages mingled together. The maximum pines seen were close to 4 feet in diameter and more than 100 feet in height. Here the pine obtains a diameter of 12 inches in about twenty years. Almost every acre of these northwestern mountains is burnt over each year by the savages, but the larger pines seem to survive these repeated scorchings. Through central Luzon the timber has been cut away, leaving small tracts of fairly good forest in a few places. In southern Luzon, in Tayabas and the Camarines, we find some large tracts fairly well covered with a variety of valuable tree species.

As we enter the southwestern islands, extending from Mindoro through to Paragua, we leave the more traveled routes, and find a sparsely settled region where the virgin forests have been apparently untouched. In this group you will find upward of 4,000,000 acres of virgin forest, extending from the water's edge to the summits of the mountains. Some cutting has been done in this region, but it has amounted to a mere thinning of the edges of the forest. This group of islands is celebrated for the great quantity of narra, or Philippine mahogany, molave, ipil, and calantas (the Philippine cedar). Here we find valuable hardwoods 4 or 5 feet in diameter with magnificent clear trunks for 80 feet up to the first limb. As a rule we find all over the islands that the largest trees have not been felled, owing to the lack of facilities for handling heavy timbers. Very little cleared land is found in Mindoro. Its reputation as a death trap for white men will change as a few hundred square miles are cleared of timber and its rich soil devoted to agriculture. A vigorous thinning of at least 50 per cent of the present forest growth of Mindoro and Paragua would make them much more salubrious than at present. The island of Mindanao, with an area of more than 23,000,000 acres, is almost entirely covered by forest. The vast majority of the population of this island is found in coast towns, with the exception of the region in the north surrounding the Laguna de Lanao, where we find a large population of Moros. Very little timber has been cut in this island owing to the scarcity of labor and the distance to market. It would be safe to estimate at least 10,000,000 acres of virgin forest for this island alone. The southern part of this island, in the region southeast of Cotabato, is noted for its gutta-percha, rubber, and other gums. More than $300,000 was paid at Cotabata for these gums last year, all of which product was shipped to Singapore. There are a number of rivers in this island sufficiently large for log-driving purposes.

Of the other large islands we find valuable forests in the islands of Leyte and Samar. The island of Negros has been cut over rather thoroughly for a great many years, and it will not be long before it will be in the same condition as the island of Cebu, if the forests are not protected. This island (Negros), prior to June, 1901, was under a separate government with its own forestry service. The forestry bureau at Manila now has jurisdiction in this island, and will promptly introduce the forestry officials trained at Manila, enforce there the forestry regulations, and protect what is left of their forests. We may safely estimate that there are at least 20,000,000 acres of virgin forest in these islands, with an average of at least 15,000 feet board measure of valuable hardwood to the acre.

Up to the present date the bureau has listed 665 native tree species, of several hundred of which little more is known than their names. During the past year about 160 different native woods have entered the market, the most valuable of which for construction purposes is molave. Molave, ipil, yacal, and dungon are remarkable for their durability and strength. The qualities of a few of these woods are very well known to the natives, and the specifications for the main timbers in house construction carefully provide that the timbers used shall be some of these mentioned. In addition to their value in ordinary construction they have exceptional qualities when used as paving blocks. Two of the bridges in Manila paved with molave blocks about six years ago have been subjected to the heaviest traffic in the city, and, apparently, at the present date, not a single block has been splintered. The calantas, or Philippine cedar, is almost entirely used in making cigar boxes. Narra, tindalo, acle, and luan are used principally as furniture woods. Betis, aranga, and dungon are generally used as piles, for which there is a great demand in the Manila market. The other important construction woods are baticulin, batitnan, amuguis, guijo, apitong, panao, sacat, balacat malabulac and malasantol.

More than 90 per cent of the native timber is used for construction purposes.

The price of timber in the log at the end of the first haul varies from 30 to 70 cents (Mexican) per cubic foot. Transportation to the Manila market is from 40 to 50 cents (Mexican) per cubic foot where parties do not use their own boats. The prices of the superior or first group woods is very uncertain, varying from $1.50 to more than $2.50 (Mexican) per cubic foot. When special sizes in the higher grade timbers are required, as much as $5 and $6 have been paid per cubic foot; this for timbers to be used in house construction.

The finest hardwoods for furniture (narra, tindalo, acle, camagon, lauan) can often be purchased at a smaller price than is paid for a few special varieties of native woods that are of particular value (molave, ipil, yacal, betis) in house construction.

Under the Spanish administration the price of timber at the end of the first haul was about 20 cents (Mexican) and much was laid down in Manila for 50 cents (Mexican) per cubic foot, and even less.

The government price on its timber, as per forestry regulations, must be paid before the timber leaves for the market. This money is paid into the nearest internal revenue office.

The government valuation of its timber and firewood has been close to 5 per cent of the current market price. The government valuation of other forest products has been uniformly 10 per cent of the current market price.

The demand for timber for house construction is strong and will continue as peace is restored and people return to their homes in the provinces and commence rebuilding.

The China market for Philippine woods is very good, but it will be some years before the people in

* Abstract from Special Report of Capt. George P. Ahern.

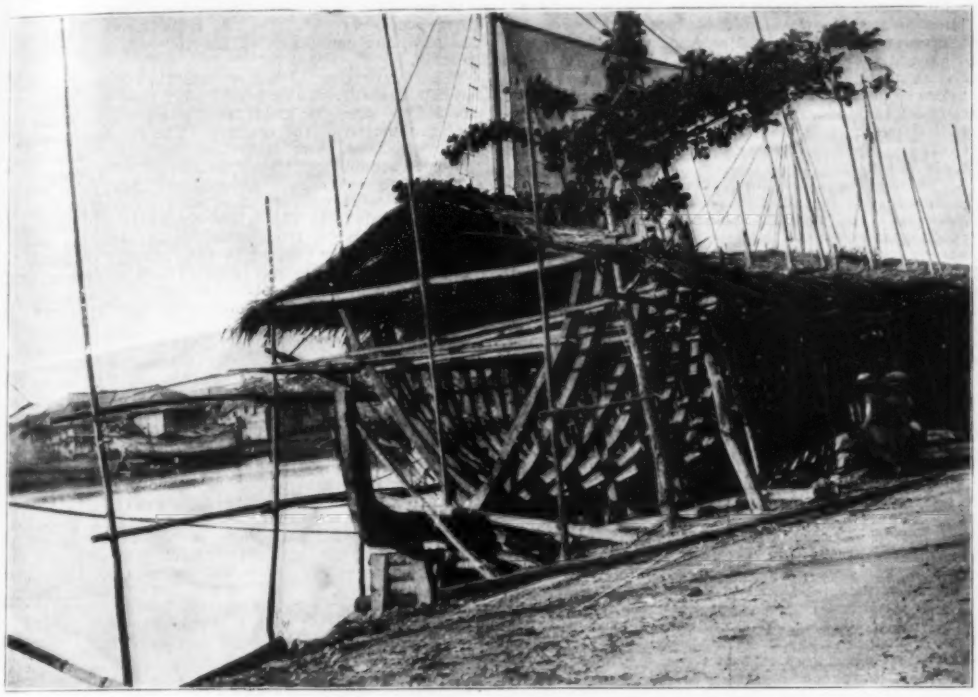
BALETE, PROVINCE OF TARLAC.

RIPPING OUT BOARDS IN THE CITY OF MANILA.

the ports of the Orient will be willing to pay the prices current in the market in Manila.

The demand for certain of our fine hardwoods by furniture and cabinet makers in the United States will arise as soon as these woods become known. We have a number of varieties of fine hardwoods which should appeal to these furniture makers.

In the course of a year or two, when American appliances and skill are at work in the forests, we should be able to place cargoes of these varieties on



SHIPBUILDING AT DAGUPAN.

board ship for not more than $1 (Mexican) per cubic foot. Transportation to the United States costs between $9 and $15 gold per 1,000 board measure. Almost any lengths can be obtained and diameters up to 5 and 6 feet. During Spanish times the large trees were left untouched owing to the lack of facilities for handling them. Occasionally a tree 6 or 7 feet in diameter would be felled and one slab taken from it, from which to make a table. Many of these fine table tops can be seen throughout the islands, some of them more than 7 feet in diameter.

Ordinarily the native loggers are paid at a fixed price per cubic foot laid down at tidewater or on railroad. There are four sawmills in the city of Manila and hundreds of carpenter shops where the Chinamen rip out boards by hand and make a fair profit. Parties desiring to purchase a few hardwood boards to make a little rough furniture will often pay from 25 to 50 cents (Mexican) per running foot for the same.

Two great obstacles are encountered in providing for a forestry service of these islands, namely, a lack of properly trained officials and, second, a great variety of unknown tree species.

The United States this year inaugurates the scientific exploitation of 50,000,000 acres of public forest land. The few foresters now in the States will be offered inducements to enter that service.

Fifty trained foresters would find ample work in the Philippine forests at the present time, but it is doubtful if appeals to the forestry service in Germany, India and Java would result in securing half a dozen men. The great objection offered by these men, as I have stated before, will be that no provision is made for retirement for disability or for age. Life in the tropics, and especially in a tropical forest, is not without considerable danger, and a foreigner can hardly be expected to leave the forestry service in his own country to go to strange lands where pernicious malaria or dysentery may incapacitate him within a few months after his arrival.

These forests can be properly cared for as soon as trained foresters are provided.

It is believed that a personal visit to Germany, India and Java by someone interested in this service, and with authority to employ, would result in securing a few men.

The next difficulty will be found in finding a market for the several hundred varieties of native woods found within a comparatively small area in almost any part of these islands.

The first step in this direction has already been made. One hundred varieties of native woods were selected, polished and labeled, and shipped to the United States, where they were placed on exhibition at the Pan-American Exposition at Buffalo, and later permanently placed in the Agricultural Department at Washington. The exhibition of these hardwoods should interest our furniture makers, and tend to divert buyers from Central and South America to the Philippines. A vast amount of hardwood is imported into the United States each year at a high price. There is no reason why many of the Philippine varieties of fine quality should not find a ready market with the furniture makers.

Many fine varieties of native woods are not popular in the Philippines on account of their non-resistance to the white ant and climate, which objections would not be met with in the United States.

The regulations provide for the felling of all trees by selection. Objections will be made by the lumbermen that there is no market for the 400 or 500 varieties of tree species thus selected. The duty of finding a market for such varieties thus devolves upon the forestry bureau. There are at present samples of more than 450 varieties of native tree species in the office at Manila. Each month will find more varieties added to this number, and in time, after investigation of the quality of these woods as to strength and durability, more varieties will become popular in the market.

The forestry school should be inaugurated as soon as possible at Manila for the purpose of training the present forestry officials.

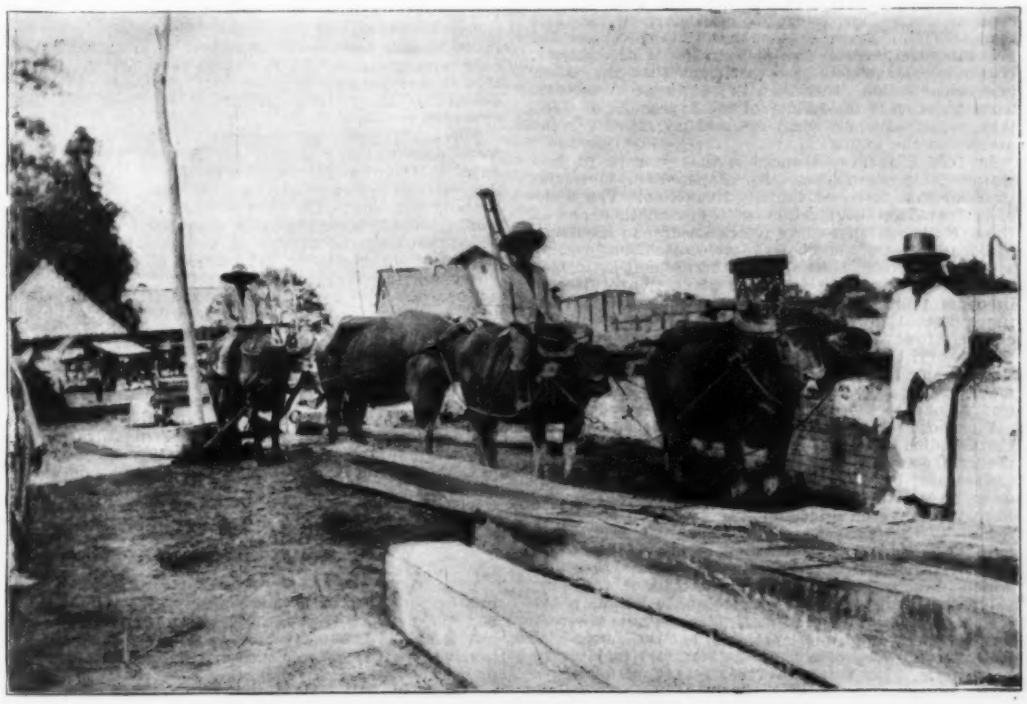
FISH-SCALE FLOWERS.

DOMESTIC industries travel in a manner that often astonishes the careful student. The Indians of Venezuela and northern Brazil have from time immemorial been skilled makers of fish-scale flowers and leaves. The denizens of the ocean in the tropics are notable for the color and brilliancy of their scales and fins, the range of chromatic tints including pink, rose, scarlet, sky-blue, ultramarine, apple-green, emerald, and olive-gold, orange, gray, lilac, and purple. The scales are easily fastened together or to wires with strong fish-glue, which is singularly durable and permanent. The industry passed to the West Indies, where it was adopted by the Spaniards and during the Cuban war came over to the mainland and found a home in Florida. In the present year it has come northward, and now finds a habitation in New York city.

One of the shops is not far from the Waldorf-Astoria, and is presided over by a clever nimble-fingered woman whose work-table looks almost as delicate as a jeweler's. Her tools are a pair of scissors, a needle and thread, cloth or threaded-wrapped wire, wire-cutters, glue-pot and brush, and some compressors for changing the curvature of the scales. The scales themselves are usually flat when they reach the operator, and must be concaved or curled in order to simulate petals, sepals, and many forms of leaves. A finished flower possesses a fantastic beauty which is unique. The shape and color of the vegetable world are present, but there is a certain transparency to all the tissues, a firmness to the lines, and a resilience to the leaves and blossoms which are never found in the floral kingdom. The play of color is often startling, and sometimes so brilliant, and yet so subdued, as to seem a new variety of the best and richest mother-of-pearl.—N. Y. Evening Post.

COOKERY OF GREEN VEGETABLES.

CONSIDERING how much has been written and said of late years with reference to the cookery of vegetables, there should be no difficulty in finding an excuse for assuming that when green vegetables are cooked otherwise than in boiling water, and thereby rendered unattractive to the eye and unpleasant to the olfactory nerves and the palate, it is because the cook is too indifferent as to the results to bring the water to the boil. Whether there be any difficulty or not in finding an excuse, it is evident there are not wanting those who believe that a process of simmering is the best to adopt in the preparation of green vegetables for the table. A contributor to an agricultural contemporary has been advising its readers to eat plenty of vegetables during the summer months, and with this advice we heartily agree, provided the vegetables are so cooked as to be appetizing and wholesome. Having suggested that plenty of vegetables should be eaten, the writer states that "it is funny how many people announce, with no air of apology, their dislike for green vegetables." It many appear "funny" to the writer, but we doubt whether any considerable proportion of those who decline green vegetables that have been cooked in accordance with the directions given do so because of the fun they derive from declining; rather should we think they do so because of the unpleasant results that follow their consumption. The writer admits this much, for she says "one reason for a frequent distaste for vegetables is the unappetizing way in which they are prepared." How they should in the opinion of the writer be prepared is thus briefly stated: "Green vegetables must be always put into cold water for cookery. Plunged into hot water they wither before they can cook, and so lose much of the flavor. The process should be slow, deliberate simmering, never swift boiling." We have had opportunities outside our own household of becoming acquainted with "deliberate simmering," and we readily admit that the process so conserves the flavor that when the cover is removed from the dish it pervades the room and is more than sufficient to satisfy the majority without their being helped to the vegetables. There may, of course, be those who enjoy this strong flavor, precisely in the same way as the Laplanders enjoy the rank flavor of the oil that forms a considerable part of their food, but its effect upon the average individual is at least to prevent him fully enjoying his dinner. We are further told that "the green things plunged into hot water and served up watery, tough, and half cold, which are so frequently offered as vegetables, are enough to implant a rooted dislike of them in anyone." Of course, if green vegetables are plunged into hot water, and the water is not made to boil, they may be watery and tough; but if they are plunged into boiling water, and the water is made to boil briskly throughout the whole of the time the vegetables remain in the saucepan, they will certainly not be tough, and if they are watery and half cold they will be in that condition because of the neglect of two of the elementary details of vegetable cookery. The rule on which we insist in the cookery of green vegetables is plunging them in boiling water and keeping the water boiling as rapidly as possible, with the lid of the saucepan removed, until they are tender, and by the observance of this rule the cook sends them to table a deep green color, and the flavor so retained in the substance that it is not perceptible until the vegetables are eaten.—The Gardeners' Magazine.



HAULING LOGS INTO RAILROAD STATION AT TARLAC.

THE DEVELOPMENT OF ELECTROCHEMISTRY.*

By R. H. JOHNSTON.

EARLY in 1800 Volta wrote a letter to an English scientist describing his newly invented pile. The information having been communicated to Nicholson and Carlisle, they immediately constructed one according to Volta's description. In May of that year they decomposed water into its constituent gases by the current from this pile. We may consider this experiment as the beginning of electrochemistry—a science which, in its applications, has recently attained considerable importance.

Nicholson and Carlisle having published the results of their experiments, many men of science turned their attention to this fascinating branch of investigation. Before the end of 1800 Cruishank performed a series of experiments which are worthy of considerable attention. He passed the current from a voltaic pile through solutions of lead acetate, copper sulphate and numerous other salts and, as a result of his observations, he formulated the principle that metals are liberated from their solutions at the same electrode (to use a term introduced later) as hydrogen. He noted that the other electrode—"the wire connected with the zinc extremity of the pile"—was attacked if made of a base metal, but that, if made of gold, oxygen was there evolved. Cruishank further remarked prophetically that the "galvanic influence" might be used with success in the analysis of minerals.

The next few years were fruitful as regards the production of theories to explain electrolysis, but no substantial advance was made until 1807. In that year Davy discovered the elements potassium and sodium, having isolated them by electrolysis of fused caustic soda and caustic potash. Moreover, he then predicted that baryta and lime could be similarly decomposed, but he was unsuccessful in his attempts to do so.

Berzelius, the great Swedish chemist, who had taken much interest in Davy's work, succeeded in 1808 in obtaining the amalgams of barium and calcium by the electrolysis of baryta and lime, respectively, in the presence of mercury. Davy, having learned of this method of procedure, in the same year obtained the amalgams of strontium and magnesium, although he was unable to obtain the pure metals.

Thus in the first decade of the nineteenth century, through the employment of the electric current to effect chemical reaction, potassium, sodium, barium, calcium, strontium and magnesium were added to the list of the known elements, and many fallacious chemical notions were overthrown.

No further progress was made until the great Faraday turned his attention to the subject. As a result of his investigations he promulgated, in 1834, his famous laws on the quantitive relationship between the amount of current and the amount of chemical reaction thereby produced. Besides these important laws, which are fundamental in the science of electrochemistry, we are indebted to Farady for the nomenclature of the subject.

THEORIES OF ELECTROLYSIS.

And now let us consider the theories which have been advanced to account for electrolysis. The hypothesis of Grotthus, offered in 1805, was quite sufficient to cover the facts then known. Grotthus supposed that when the current is flowing one electrode is charged positively and the other negatively.

The molecules of the electrolyte, copper sulphate, for example, become polarized and arrange themselves in order, the Cu being positively charged and the SO_4 negatively charged. Therefore, he reasoned, the copper ions point toward the cathode and the sulphions toward the anode. Consider a single row of molecules from electrode to electrode. The copper atom in the molecule nearest the cathode has its charge neutralized, and is liberated as metallic copper. The sulphion, SO_4, thus released, instantaneously combines with the Cu of the next molecule, and a similar exchange takes place all along the line, till at the anode, the last SO_4 having no Cu atom with which to combine, either unites with the anode or enters in combination with the water used as a solvent.

For a long time this hypothesis was generally accepted. But the investigations of Hittorf, in 1853 and the succeeding years, showed that this hypothesis did not completely cover the phenomena of electrolysis. Hittorf demonstrated by experiment that the anion and the kation travel with different velocities. Thus he exposed the fallacy of the hypothesis of Grotthus, which assumes equal rates of migration for the anion and the kation.

In 1857 Clausius advanced a theory more in harmony with modern ideas. He supposed the molecules in a solution to be continually in motion. The molecules traveling about collide with one another, and in these collisions there frequently occurs an exchange of ions between neighboring molecules. On passing a current through the solution, the exchanges, instead of taking place in an irregular manner, are directed in definite directions, the positively charged ions being attracted toward the cathode and the negatively charged toward the anode. Therefore, according to this theory, the current does not cause the decomposition of the molecules, but simply guides these ions, momentarily free, so that their motion is in the direction of one of the oppositely charged electrodes.

The most recent theory is that advanced in 1887 by the Swedish scientist Arrhenius. According to this theory, some of the molecules of a dissolved electrolyte are, by the mere process of solution, already dissociated into ions, the degree of ionization increasing with increased dilution. The investigations which led up to this theory are of considerable interest.

In 1877 Pfeffer published a paper giving the results of his laborious researches on the osmotic pressures which dissolved substances exert against the pure solvent. As his work was carried on solely as a biological research, he did not indicate its bearing on any chemical or physical problem, but the data which he collected were of the greatest service to later investigators. De Vries, in 1884, as the result of osmotic experiments, found that equimolecular solutions exhibit equal osmotic pressures. Hence, he concluded, that the magnitude of the osmotic pressure is conditioned only by the number of molecules in solutions.

Van't Hoff, in 1887, pointed out for the first time the relation between gases and dilute solutions. He demonstrated from Pfeffer's results that the osmotic pressure is proportional to the concentration and to the absolute temperature. He further showed that the osmotic pressure of a dilute solution is the same as the gas pressure of a gas at the same temperature, containing the same number of molecules in unit space as there are molecules of the dissolved substance in unit volume of solvent.

Thus he had shown that the three laws governing gas pressure—the laws of Boyle, of Guy Lussac and of Avogadro—apply to osmotic pressure. But he found that the osmotic pressures of a large class of substances do not conform strictly to these laws. The exceptions included all substances whose solutions conduct the current. For all such substances he found the osmotic pressure greater than that calculated from the gas laws.

Arrhenius suggested that this increased pressure was due to the fact that some of the molecules had dissociated. He justified such a radical hypothesis by calling attention to the fact that many gases show apparent variations from Avogadro's law, and that this variation is generally explained by assuming that such a gas undergoes dissociation.

In working out his theory, Arrhenius reasoned as follows: The osmotic pressure is proportional to the number of ultimate particles in solution. If a dissolved substance exhibits a pressure greater than that calculated for it in its normal condition, the increased pressure is due to an increase in the number of ultimate particles. This increase can come about only through the dissociation of some of its molecules into ions.

The process of electrolysis according to the theory is as follows: On the passage of a current through an electrolyte, such as the aqueous solutions of a metallic salt between two insoluble electrodes, the cations carrying positive charges flow to the cathode and there give up their charges, thereby becoming ordinary molecules and appearing at the surface of the cathode as metal, or as the product of the action of this metal on water. Similarly the anions carrying negative charges flow to the anode and there give up their charges, appearing as ordinary molecules, or as the product of their action on water. The function of the current is to neutralize the charges thus given up at each electrode; and to allow the ions thereby to assume their ordinary molecular condition.

Naturally a theory embodying such radical conceptions met with great opposition. Chemists are reluctant to accept the idea of, for example, free Na and Cl in a solution of sodium chloride. Moreover, objection was made that the theory rested on a rather slender experimental foundation. Nevertheless, the theory is gradually being accepted by scientists. It furnishes a satisfactory explanation of many phenomena, and its very able exponents have adduced much evidence tending to establish the theory.

Fortunately the commercial applications of electrochemistry can be intelligently considered without regard to the theories as to the exact manner in which electrolysis proceeds. Some of the more important applications will now be separately considered.

ELECTROPLATING AND ELECTROTYPING.

In 1839, Spencer and Jordan, of England, and Jacobi, of St. Petersburg, almost simultaneously described their experiments in obtaining electrotypes. Jacobi published a method of converting into relief, by galvanic means, even the finest lines engraved upon a copper plate, thus producing a plate which could be printed from. Jordan set forth a method of multiplying engraved plates, etc., by forming a matrix of the object and using the "negative" copy thus obtained to reproduce the original form. Spencer, in addition to describing similar experiments, showed how objects of wood or other non-conductive substances could be plated with copper if they were first coated with a film of bronze powder or gold-leaf.

The application of the art to the requirements of the printer was made possible, in 1840, by Murray's discovery that molds of non-conducting material could be made to take the deposit of copper by brushing them over with graphite. In the same year, Wright found that it was possible to plate with gold and silver by depositing them from solutions of their alkaline cyanides.

For many years all attempts to plate with nickel were unsuccessful. Adams, of Boston, who investigated this subject in 1869, found that the failure was due to the presence of traces of nitric acid in the plating solutions. He showed that if this impurity was removed, nickel plating was perfectly feasible. Since that time, no notable advance has been made in the art of electroplating. The actual process of plating is too well known to need description.

However, the Cowper-Coles process of making parallelic reflectors for search-lights, in which process electroplating finds a unique application, is worthy of some attention. A convex glass form is prepared of the desired shape. This is then given a thin coating of silver by chemical means and then copper is plated over it to any desired thickness. The whole is then placed in water which is heated and the metallic reflector then separates them from the glass, owing to the unequal expansion of the two. The reflector is next plated with a thin coating of palladium and, after polishing, is ready for use. This process seems to work very satisfactorily, plants having been established in both England and the United States.

METAL REFINING.

In 1836, Becquerel planned works for the treatment by electrolysis of minerals containing copper and silver, but, needless to say, the works were never erected owing to the prohibitive expenditure of battery zinc involved in the process. But with the advent of a practical dynamo, in the later years of the sixties, refining by electrolysis was made commercially possible.

The first patents bearing on the electrolytic refining of copper were taken out by Elkington, of Birmingham, in the years 1865 and 1869. The process therein described exhibits all the essential features of the method in use to-day. In 1870 the Swansea works erected by Elkington started up. In the next few years several small refineries were built in Germany and France, and finally, in 1879, the first works in the United States were started in Phœnixville, N. J.

For the next ten or fifteen years most of the development in the electrolytic refining of copper took place in Europe, and much of the copper produced in this country was refined abroad. But with the opening of the Boston and Montana refinery in 1893 the Guggenheim works in 1895, and the great Anaconda refinery in 1896, the conditions of the industry changed completely.

There are now eleven eletrolytic copper refineries in this country. Their product for 1900 was estimated as 210,000 tons, or about four-fifths of the total copper production of the country. The refining of copper is by far the most important industrial application of electrochemistry. This method of refining owes its success to two great advantages; first, the copper deposited is particularly fine, and, secondly, all of the gold and silver in the crude copper is left behind in the anode sludge, from which it is easily recovered. From the copper treated in this country in 1899, 19,400,000 ounces of silver and 174,000 ounces of gold were recovered. In other words, one-third of the silver produced in this country in that year was derived from copper ores.

In the actual process of refining, the anodes are of crude copper, about 98 per cent pure, cast into plates of convenient size. The cathodes are thin sheets of the pure metal. The electrolyte is a solution of copper sulphate which is kept in constant circulation. As the energy expended in depositing the copper on the cathode is balanced by the energy furnished by the copper of the anode going into solution, it is evident that little external energy need be supplied other than that expended in overcoming the resistance of the electrolyte.

There are two variations in the process. By the usual system, the "multiple" system, the plates in each vat are alternately anode and cathode, all the anodes being connected in parallel and all the cathodes in a similar manner. The Anaconda refinery is a typical one employing this system. The plant has 1,400 vats, each 8 feet, by 5 feet by 3½ feet deep, and containing 880 gallons of sulphate solution. In each vat there are twenty cathode plates and nineteen anode plates, the latter weighing, when new, 8,200 pounds. The drop of voltage across each vat is but 0.3 volt. The current used is 4,000 amperes, corresponding to a current of 13 amperes per square foot, and 210 pounds of copper are deposited in each vat in twenty-four hours.

In the Hayden, or "series" system, in use at the large refinery at Baltimore, the plate at one end of the vat is the anode, that at the other end the cathode. The intermediate plates of crude copper act as anode on one side and cathode on the other. Thus the impure copper is dissolved from one side of the plate, and on the other pure copper is deposited. Finally, the plates are entirely converted into pure copper and are removed from the bath. The "series" system is practicable only when the crude copper is of very high grade, so that it can be rolled into thin sheets and uniformly attacked in the refining vat.

The copper electrolytically refined is about 99.93 per cent pure. As the deposited copper exhibits a slight crystalline structure it is generally melted and recast before being placed on the market.

Elmore has devised a process whereby the copper is deposited in the form of tubes ready for use. The copper is deposited on a slowly rotating steel mandrel, and the freshly deposited surface is continuously burnished by an agate burnisher which travels to and fro along the length of the mandrel. Each layer of metal being thereby compressed, the resulting tube possesses great density and solidity. The surface of the steel mandrel is covered with plumbago to prevent the too close adherence of the copper, and to allow the finished tube to be readily removed. The companies exploiting this process have met with a limited degree of success.

A great desideratum in any refining process is to secure a rapid output. At present the usual current density in copper refining is 10 to 20 amperes per square foot. Cowper-Coles proposes to use a current density of 200 amperes per square foot by depositing the copper on rapidly revolving drums. He claims that the friction between the revolving cathode and the solution will result in burnishing the copper, giving it great solidity. When a coat of copper sufficiently thick has been deposited it can be cut off in sheets ready for use without recasting. This process has not passed beyond the experimental stage.

The refining of silver in such a manner that the small quantities of gold associated therewith may be recovered is another process which is very satisfactorily accomplished by electrochemical means.

In such a process it is not necessary to obtain the deposited metal in sheet form, as silver in crystals is readily melted into bars. The important consideration is to secure a rapid output, owing to the great value of the metals treated. Therefore as high current is employed as is possible without carrying over the impurities from the anode or unduly heating the electrolyte. A high current density being used, the silver crystals would soon form short circuits by bridging over from cathode to anode, if some means were not employed to remove the crystals as fast as they are formed.

These fundamental principles were first recognized and commercially applied by Moebius, who, in 1884 and 1895, patented the only forms of apparatus now in use.

In the older Moebius process a fork-shaped scraper travels back and forth across the cathode, a prong on either side breaking off the deposited crystals. These crystals fall to the bottom of the vat into linen receptacles, which can be lifted from the vat from time to time and the silver crystals collected. The anodes of crude silver are inclosed in bags of filter-cloth, to catch any particles of gold which may be disengaged. This process was put into operation in 1886 at the plant of the Pennsylvania Lead Company,

* School of Mines Quarterly.

near Pittsburg. Two German refineries also employ the process.

The new Moebius system was installed at the Guggenheim works, at Perth Amboy, in 1895, and at the Globe Refinery, in Denver, in 1898. This differs from the older process in the respect that the cathode is an endless moving band of silver, one-third of an inch in thickness. It deposits its silver on another traveling band, from which it is scraped outside the vat.

With both forms of apparatus the electrolyte is silver nitrate, to which nitric acid is added from time to time. The silver refined by this process is 999 to 999½ fine. In fact, the bullion to be exported is first melted up with a little copper, as the English buyers refuse to recognize a greater degree of purity than 998.

At two establishments in Germany and at the Philadelphia Mint gold is electrolytically refined by the Wohlwill process. The anodes are of gold already reasonably pure, and the cathodes are thin sheets of pure gold. The electrolyte is a mixture of the solutions of auric chloride and sodium chloride, and is maintained at a temperature of 60 deg. C. to 70 deg. C. A current density of 100 amperes per square foot is used, thus securing a rapid output. The platinum and other "impurities" are dissolved at the anode, but are not deposited at the cathode. Thus gold of a purity of 999.8 is obtained. At intervals the platinum is recovered from the electrolyte by precipitation with ammonium chloride.

Nickel is electrolytically refined at two or three plants. There are numerous well-known difficulties attendant on such a process, and in just what manner these have been surmounted has not been disclosed.

PROCESS OF EXTRACTION.

Electrochemical processes of extracting copper from its ores have been unsuccessful. The first experimenters in this field endeavored to apply the methods of refining to the process of extraction. An elaborate and costly trial given to the Marchese process in 1885 proved the impracticability of this procedure. The anodes were cast of copper matte, containing about equal proportions of copper, iron and sulphur. The cathodes were of pure copper, and the electrolyte a solution of iron and copper sulphates. Among the numerous difficulties causing the immediate abandonment of the process were the irregular attack on the anode, causing its disintegration and the increasing resistance in the vat, due to the coating of sulphur left behind at the anode.

In the processes next devised the metal is extracted from the ore by a suitable solvent, and the solution is then electrolyzed with an insoluble anode. Two such processes were contrived in 1887, one by Siemens and Halske, the other by Hoepfner.

In the Siemens-Halske process the ore is first roasted and then leached with a solution of ferric sulphate. The copper is thereby dissolved, and the solvent is reduced to ferrous sulphate as follows:

$$Cu_2S + 2Fe_2(SO_4)_3 = 2CuSO_4 + FeSO_4 + S.$$

The solution—the mixture of ferrous and cupric sulphates—being submitted to electrolysis, the copper is deposited to the exclusion of the iron.

The anodes are made of carbon and a porous diaphragm is used. The solution is fed first to the cathode compartments. Having circulated through all of these, it consists mainly of ferrous sulphate, the copper having been deposited. The solution is then circulated through the anode compartment and is oxidized back to ferric sulphate. It is then conducted back to the leaching vats to extract more copper.

At first sight such a process seems perfectly feasible, but in actual operation numerous difficulties were found to occur which rendered it unprofitable. The ores had to be crushed exceedingly fine, and even then an approximately complete extraction of the metal was very uncertain. Moreover, the use of a diaphragm was inherently a bad feature, as its life was limited, and it increased the resistance of the bath. Other difficulties of manipulation also presented themselves. The Hoepfner process, in which a mixture of chlorides was used as a solvent, likewise proved a failure when given a commercial trial.

GOLD.

In the cyanide process of treating gold ores the electrolytic process has been employed with great success. The extraction of gold from its ores consists in acting on them with a solvent which will not appreciably attack the non-auriferous part of the ores. The usual solvent, mercury, is not adapted for these ores in which the gold occurs in fine particles, for it then floats away without coming into contact with the mercury. For this class of ores the cyanide process is peculiarly adapted.

The pulverized ore is leached with a weak solution of potassium cyanide, the gold being dissolved according to the equation:

$$4Au + 8KCN + 2O + H_2O = 4AuKCN_2 + 4KOH.$$

The method first employed for recovering the gold from the cyanide solution was precipitation with metallic zinc. As a substitute for the zinc-precipitation method, Siemens perfected a process for the electrochemical deposition of the gold from the cyanide solution. In 1894, the first plant employing the Siemens process was erected at the Worcester mine near Johannesburg. Its operation was so successful that many of the other South African companies soon adopted the electrochemical method of recovery.

The cyanide liquor is electrolyzed between a thin sheet-lead cathode and an iron anode. A current density of 0.05 ampere per square foot is used, and a constant circulation of the electrolyte is maintained. The iron anode is attacked, forming Prussian blue, but this action takes place but slowly and does not seriously interfere with the efficiency of the process.

It is an interesting fact that in many of the plants which continue to employ the zinc-precipitation method, it has been found advantageous to coat the zinc with lead by dipping it in lead acetate. Each strip of zinc thus acts as a voltaic couple, producing electrolytic effects.

LEAD.

At the plant of the Electrical Lead Reduction Company, at Niagara Falls, spongy lead is produced from galena. The galena is powdered and placed in lead pans. These pans are so arranged in nests that the bottom of each pan and the galena within act as cathode, and the under side of the pan placed above it acts as anode. The electrolyte is dilute sulphuric acid. The hydrogen liberated at the cathode reacts with the galena as follows:

$$PbS + H_2 = H_2S + Pb.$$

The hydrogen sulphide and the oxygen set free at the anode are conducted away and converted into sulphuric acid. The spongy lead which results from the reduction is either pressed into plates for storage batteries or roasted to form litharge.

ALUMINIUM.

In 1854, Deville, professor of chemistry in the École Normale at Paris, succeeded in obtaining metallic aluminium by electrolyzing the fused double chloride of aluminium and sodium. As the only source of electrical energy then available was the primary battery, Deville saw the hopelessness of a commercial application of his discovery and, therefore, he turned his attention to the purely chemical methods of preparation, in which likewise he was the pioneer. During the period 1861 to 1885 a number of electrolytic processes were patented which resembled one another in the respect that they all contemplated the electrolysis of a fused halogen salt of aluminium. They differed in the respect that in some, cryolyte was to be used; in others, a mixture of the chlorides or fluorides of aluminium and sodium. Moreover, each inventor had his peculiar notions as to the method of heating, the arrangement of electrodes and other details. Some of these processes were given a short commercial trial, but they could not successfully compete with the chemical process of reduction with metallic sodium.

In 1885, the Cowles Brothers patented their process of reduction of alumina with carbon in the electric furnace, in the presence of another metal with which the liberated aluminium forms an alloy. As the sole function of the electric current is, in this process, to supply the *heat* necessary for the reaction, its consideration does not properly fall within the scope of this paper.

In 1886, Hall devised a process for the electrolysis of alumina dissolved in a bath of fused fluorides. When Hall applied for a patent the Patent Office authorities declared an "interference" with an application made by Heroult, of France. Therefore, we may conclude without further evidence that the Hall and Heroult process are identical in principle. Hall was finally granted the patents for this country, and Heroult, who had made an earlier application in the European countries, received the patents abroad.

The Pittsburg Reduction Company was organized to exploit the Hall process. A plant was erected near Pittsburg, and in 1888 the aluminium made by the process was put on the market. The company was successful from the start, and on the completion of the Niagara Falls power plant the business was moved to that place. The company has won several lawsuits involving the validity of their patents and, therefore, they have a monopoly in this country of the manufacture of aluminium until 1906, the date of the expiration of Hall's patents.

The actual manufacture as conducted at Niagara Falls has been described as follows: "The vessels employed in the making of aluminium are rectangular iron boxes thickly lined with carbon and exhibiting a cavity in the carbon about 4½ feet long by 2½ feet wide and about 6 inches deep. The carbon lining constitutes the cathode. The anodes, forty in number, four rows of ten, consist of carbon cylinders about 3 inches in diameter and 18 inches long when new. They are supported above the pot, dipping into the bath of fused fluorides. No external heat is employed, the heat developed by the resistance to the current being all that is necessary to maintain fusion. Alumina is added from time to time as required. The process proceeds quietly day and night. The yield is about 100 pounds aluminium per pot every twenty-four hours."

The solvent used consists of about three parts by weight of aluminium fluoride, one part of sodium fluoride and one of calcium fluoride. This dissolves about 20 per cent of its own weight of alumina. The fluorides are not affected, but the alumina (Al_2O_3) is decomposed. The liberated oxygen attacks the carbon anodes, which are gradually consumed. The molten aluminium is tapped off at intervals.

The meager statements describing the workings of the Heroult process indicate that it differs from the above but slightly. Not much was done abroad under the Heroult patents until after the success of the Pittsburg Reduction Company in this country, when several plants in Europe commenced manufacturing aluminium by this process, and by 1891 the establishments manufacturing the metal by the old chemical process were driven out of the field.

At present there are nine works in the world engaged in the manufacture of aluminium under the Hall or Heroult patents. The Pittsburg Reduction Company operates two plants at Niagara and has recently opened a third at Shawenegan Falls, Canada. The British Aluminium Company operate a large plant at Foyers, Scotland. There is an establishment at Neuheusen, Switzerland, two in France, one in Germany and one in Austria. The output for 1901 is estimated at 7,500 metric tons. Aluminium is now regularly used in all steel works, being added at the rate of 4 to 6 ounces per ton of steel. It is competing with copper as a conductor in electrical transmission lines, as it offers twice the conductivity for equal weight. It is being used for numerous other purposes and the market for the metal is widening year by year.

SODIUM.

Although sodium was first isolated by electrolysis, no satisfactory commercial process of obtaining the metal in this way was devised until quite recently. Many attempts were made to make sodium by the electrolysis of the fused chloride, but none of these methods were successful, the principal difficulty being the violent corrosive action both of the fused salt and the liberated products. Moreover, salt fuses at the high temperature of 800 deg. C. and sodium begins to distill off below 900 deg. C., so the collection of the product was extremely difficult.

In 1890, Castner devised a successful process of making sodium by the Davy method of electrolyzing fused caustic soda. The fused hydroxide is electrolyzed between iron electrodes. No diaphragm is used, but a wire gauze is interposed between the electrodes. The sodium liberated at the cathode is thus prevented from straying into the anode compartments, as its high surface tension prevents it from straying through the gauze. On the other hand the fused hydroxide circulates freely. The liberated sodium floats at the top of the cathode compartment and is baled out from time to time.

Practically all the sodium used in the world is prepared by this process. It is operated by the Niagara Electrochemical Company and by factories located at Bitterfeld, Rheinfelden and Frankfurt in Germany, Bellegarde and Les Clavaux in France, and Weston Point in England.

Large amounts of sodium are converted into the peroxide for use in bleaching and for other purposes where a powerful oxidizing agent is required. It gives off 18 per cent of its weight in available oxygen. The peroxide is easily prepared by burning sodium in an excess of dry air free from carbon dioxide. Sodium is also converted into the cyanide by adding it to melted ferrocyanide the reaction being:

$$K_4Fe(CN)_6 + 2Na = 4KCN + 2NaCN + Fe.$$

The suggestion has been made that, in the future, sodium may be used as a compact, amenable, and portable form of energy.

CAUSTIC SODA.

Many attempts extending over a number of years have been made to manufacture alkali and chlorine by the electrolysis of common salt. Several successful processes have been devised and these are being worked on an ever-increasing scale. In 1884 three German chemical firms united in carrying on experimental work, and as result of their investigations a plant was opened at Frankfurt in 1890 to work the "Electron" process. This plant was the first to achieve success in the electrolytic alkali industry.

In the "Electron" process the electrolyte is a solution of common salt and a diaphragm is used to prevent the alkali formed at the cathode from coming into contact with the chlorine evolved at the anode. No other details of the process have been made public except that the diaphragms are made of cement and have a life of two years. In the "Electron" process, and, indeed, in all other electrolytic alkali processes, the chlorine is conducted into lime chambers to form bleaching powder. The "Electron" cell has been widely adopted for the manufacture of alkali and bleach, and there are now eleven works in Europe using this form of cell.

We may class with the "Electron" process the Le Sueur, the Hargraves-Bird, and the Onthendin-Chalandre processes, as in all of these a diaphragm is used. The Le Sueur process has been worked on a small scale in this country since 1892, first at Rumford Falls and later at Berlin Falls. The Hargraves-Bird process has been operated at an establishment in England since 1896. The Onthendin-Chalandre, the latest modification of the "diaphragm process," is in operation at two works on the Continent.

The difficulties in working with fused salt were referred to when sodium was being considered. Despite these difficulties, three processes in which the electrolyte is fused with common salt have been given a trial. These processes resemble each other in the respect that all employ a cathode of molten lead. The resulting sodium-lead alloy is withdrawn and treated with steam to form alkali and the lead is then returned to the cell. Vautin, in 1893, patented such a process, which, after a short trial, was abandoned. Hulin, in 1894, improved on the process and a plant at Les Clavaux worked the process for two years, but found it to be uneconomical. These two trials demonstrated that a small proportion of sodium forms an alloy with lead which is not very mobile, resulting in making the circulation of the alloys very difficult. Moreover, the action of steam on the alloys was found to be "dangerously violent." In spite of these experiences a plant has been erected at Niagara to work the Acker process. Although this process embraces decided improvements over those of Vautin and Hulin, it is doubtful if the fundamental disadvantages of working with fused salt and a molten lead cathode have been overcome. This conclusion is strengthened by the fact that the plant at Niagara Falls, although finished several months ago, has not yet commenced regular operations.

In a third type of apparatus, the alkali is removed from the influence of the anode by gravity. The first process of this kind, the Holland and Richardson, was put in operation at St. Helens, England, in 1895. The history of the company owning the plant is said to have been "a long series of disappointments to the stockholders," and, finally, in 1901, the plant was closed. The "Bell" process, another gravity process, which was perfected in 1899, after several years of experiment, seems to be more successful.

In this process the inflow of brine and the outflow of alkaline liquor are so regulated that the separating zone, where the anode and cathode liquors meet, is maintained at a constant level at a safe distance below the anode.

Probably the most successful process now in use is the Castner-Kellner, patented in 1892 and 1893, and in operation at Weston Point, England, and at Niagara Falls since 1896. At the English plant 4,000 horse power is utilized, and at Niagara the Mathieson Alkali Works, the largest in the world, devote 6,000 horse power to the process.

The Castner-Kellner apparatus consists of a shallow trough divided into three compartments by two partitions which extend almost to the bottom of the cell. There is a layer of mercury in the cell sufficiently deep to seal the compartments from each other. In each of the outer compartments there is a carbon anode, and in the middle compartment an iron cathode. Brine is fed into the outer compartments, and water into the middle one. In the other compartments the salt is decomposed. The chlorine which is evolved is conducted away, and the sodium alloys with the mercury,

which here acts as cathode. A gentle rocking motion is given the cell, so that the alloy is transferred to the middle compartment, where it acts as anode and the sodium is extracted, and, combining with water, forms caustic soda. The efficiency of the electrolysis of the salt in the outer compartments is 90 per cent, while the efficiency of the extraction process in the middle compartment is 100 per cent. Therefore, to prevent the oxidation of mercury in the middle compartment, only 90 per cent of the current which flows through the outer compartments is sent through the middle one, the division of current being readily brought about by means of a shunt.

Another process employing mercury is the Solvay process, in use at Jemeppe, in Belgium, since 1898, and later introduced at two other European establishments. An amalgam of sodium is formed during the electrolysis, and this amalgam floats on the top of the mercury cathode. The mercury is circulated toward a weir of such a height that the amalgam passes over it. The amalgam is then conducted to another cell, in which it acts as the anode, and the sodium is extracted as in the Castner-Kellner process, the mercury being then returned to the original cell.

At several establishments in Europe and at the Roberts Electrochemical Works at Niagara Falls, caustic potash is manufactured from potassium chloride by processes similar to those above described.

HYDROCHLORITES AND CHLORATES.

In describing the process for making caustic soda, attention was called to the various methods employed for preventing the alkali from reacting with the chlorine. In the manufacture of hypochlorites and chlorates, the problem is, on the contrary, how this secondary reaction may best be brought about and controlled. In general, hypochlorites are formed by the action of chlorine on the caustic alkalies in cold solutions, and chlorates are formed when the reaction takes place in warm solution. The difficulty is to prevent the hydrogen set free at the cathode from reducing these products.

The various forms of hypochlorite apparatus resemble one another in the respect that no diaphragms are used and a rapid circulation of the electrolyte from the cathode toward the anode and thence out of the cell is maintained. The electrolyte is either sodium chloride or potassium chloride. Hypochlorite solutions for bleaching wood-pulp and textile goods are made in numerous small plants on the Continent, but this practice has not been largely adopted in the United States or England.

The electrolytic chlorate industry has attained larger proportions, two-thirds of the world's supply of the commodity being thus produced. The electrolytic process was first worked on a commercial scale by Gall and Montlaur in 1889. They employed a diaphragm cell, in which the alkali formed in the cathode compartment was conducted through the anode compartment. As in all other electrolytic chlorate processes the electrolyte was maintained at a temperature of 50 deg. to 75 deg. C. This cell is still in use at some of the European works.

The Franchot and Gibbs cell, patented in 1893, was used by the National Electrolytic Company at Niagara Falls from 1898 until quite recently. In this cell no diaphragm is used. The cathodes are made of cupric oxide with which the liberated hydrogen combines, thus preventing reduction of the chlorate. Although the efficiency of the process was high, the disadvantages attendant on renewing the copper oxide cathodes led to the modification of the process. In the cell now used at Niagara, the cathode is composed of copper wires whose rounded surfaces facilitate the escape of the hydrogen bubbles. The electrolyte is circulated through the cell at such a rate that the outflowing liquor contains about 3 per cent of chlorate which crystallizes out of the liquor on refrigeration.

Müller has recently discovered that the addition of a small percentage of chromate in the chlorate cell greatly increases the efficiency of the process, and this device has been generally adopted. Brochet believes that in all cases, hypochlorite is first formed and that the presence of chromate facilitates the secondary reactions whereby the hypochlorite is converted into chlorate.

The great chlorate works of Corbin et Cie at Chedde have recently commenced to manufacture perchlorate by electrolyzing a cold concentrated solution of chlorate. This product, because of its high oxygen value, is used in making explosives.

CONCLUSION.

The most important electrochemical industries have now been considered. There are a few processes worked on a small scale, concerning which not much information is obtainable. Numerous other processes are in the experimental stage or are still confined to the laboratory. When we consider how many able investigators have recently turned their attention to electrochemistry, we may safely predict that, in the next few years, great development will take place in this field.

WIRELESS TELEGRAPHY AND SUBMARINE CABLES.*

By E. GUARINI.

I PROPOSE in this article to discuss Mr. Mervyn O'Gorman's idea, viz., that the *coherer* might render valuable service to submarine cables. The advantages of the *coherer* (it might be better to say *imperfect contact*, as there are also *anti-coherers*) in the above-mentioned connection, would lie in the great sensibility of this little apparatus, this special eye, sensitive to an invisible light, the electro-magnetic waves. This sensibility is 10^{-14} of a watt, whereas in an ordinary relay it is 10^{-6}

The employment of such a sensitive apparatus as the imperfect contact would enable submarine cables to realize all or some of the three following advantages: (1) An increase in the speed of transmission, which, as we know, depends on the sensitiveness of the receiving apparatus. (2) A diminution in the electromotive force required, which, according to the case in question, would increase the safety of the insulating material in existing cables, and would enable this insulating material to be reduced in new ones. (3) A diminution in the section of the conductor by a reduction in the current required for the receiver. The simplest mode of applying the imperfect contact

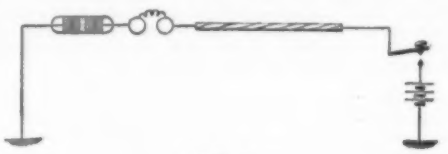


FIG. 1.

to submarine cables is that indicated in Fig. 1; at the transmitter the cable is brought to the earth through a key and a battery; at the receiver a very sensitive relay is connected to earth through a coherer, which becomes conductive when a difference of potential, say, of 2 volts, is applied to its terminals.

One of the terminals of the coherer is at the potential of the earth; we will call this zero. When, on closing the key the other terminal of the coherer is brought to a potential of 3, for instance, the coherer (for the sake of brevity we will continue to use this

FIG. 2.

term, with the reservations mentioned at the beginning of this article) will become conductive (since 3 > 2) and the relay will be influenced.

This arrangement is merely theoretical. In reality the current which acts upon the coherer, is the same in intensity and electromotive force as the one working the relay. Hence it is the same thing as suppressing the coherer.

We must, therefore, adopt the arrangement shown in Fig. 2; the relay with a local battery is put in shunt at the terminals of the coherer. It is seen that while

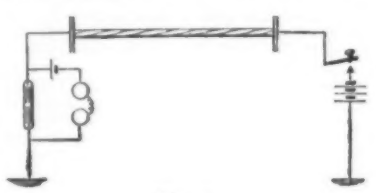


FIG. 3.

an extremely feeble current will be sufficient to act upon the coherer, the relay is worked by the local battery. In Fig. 3 we see what happens to the arrangement when the cable is cut by condensers.

In order to lessen to a very great extent the effect of the earth currents on the coherer, the arrangement shown in Fig. 4 may be used: the condenser, at the receiving end, is placed between the coherer and the earth. In order to entirely suppress these disastrous effects (earth currents) we should avail ourselves of the arrangement shown in Fig. 5, in which the connection to earth, at the receiver of Fig. 3, is replaced

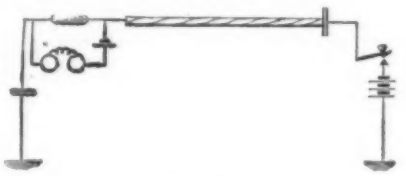


FIG. 4.

by a suitable capacity. Fig. 6 shows the arrangement of the double stations—i. e., the ordinary arrangement—diagrammatically, in which the coherer (with a battery and a relay, or a recorder such as a recording siphon in shunt) takes the place of the ordinary receiver. In order to screen the coherer from the influence of the electro-magnetic disturbances produced on the opening and closing of the key, the coherer and its connections (Fig. 4) are inclosed in a suitable metal sheath (see Electrical Review, July 12, 1901). In the normal state the circuit of the receiver (Fig. 7) consists of two earth connections, the coherer and its connections, the key, a relay or a recorder and one cell of the battery of the transmitter. When transmission is taking place, the co-

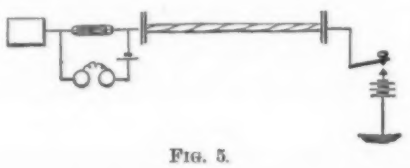


FIG. 5.

herer on the one hand, and the relay or any apparatus substituted for it on the other, are put out of circuit.

In order to obtain the raising of the pressure in the circuit of the coherer and to effect the sending of connected signals when a dash is transmitted (up to the present we assume the transmission to be effected by dots and dashes) we use the arrangement shown in Fig. 8. In the normal state the fine wire circuit of the induction coil (provided with an interrupter for the transmission) is in circuit with a coherer, a relay (or other apparatus) and one element of a battery. The thick wire circuits of the two induction coils at the two stations are on *open circuit* (English patent 1,555—1900, Electrical Review, January 11 and 18, 1901), although it is a case of low frequency (in the case before us the capacity—that of the cable—is very great). The arrangement shown in Fig. 9 is a modi-

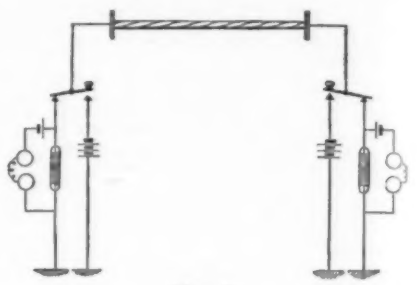


FIG. 6.

fication of the arrangement in Fig. 8; on the one hand the coherer is protected by a metal sheath, on the other the free terminals of the thick wire circuit of the transformers are connected to earth through condensers.

If we stop at the arrangements above described, we cannot hope to obtain very high speed of transmission unless we have recourse to multiple-communication. One cause of the high speed of transmission in submarine cables and land lines also is due to the use of short signals alternately positive and negative. With a coherer it would at first sight seem difficult to realize this, i. e., a selection of signals according to the sign of the current. But we will try to arrive at it in a somewhat roundabout way by using two co-

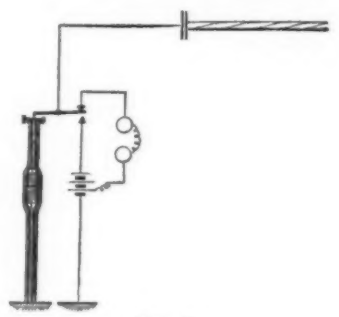


FIG. 7.

herers. This is the principle of our method: If we have two coherers working for a difference of potential, x, if we bring one of the terminals of one coherer to the potential $+ a$, and one of the terminals of the other coherer to the potential $- a$, if we bring the other terminals of the two coherers to the potentials $+ b$ and $- b$, and if we fulfill the two conditions: (1) $x < (\mp a) - (\pm b)$; (2) $x > (\mp a) - (\mp b)$, according to the sign of the current received, one or

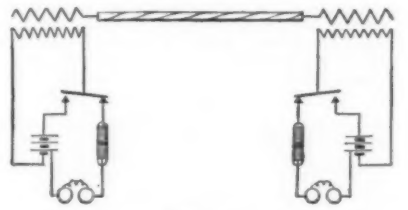


FIG. 8.

the other of the coherers will be influenced; by a special arrangement of circuits and the use of a suitable apparatus, the nature of the current can be discerned by means of a local battery. The coherers then act as two selecting relays.

Fig. 10 relates to one of the modes of applying the

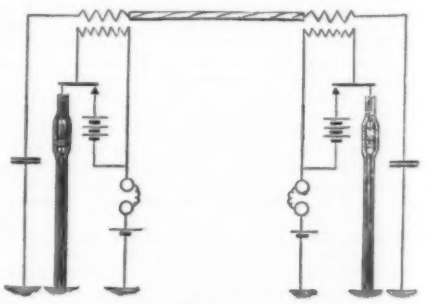


FIG. 9.

above principle. The line wire is divided at B. (1) It is brought to earth through a galvanometer; (2) it is brought to earth through a coherer, one terminal of which is brought to the potential — 2 by a battery; (3) it is brought to earth through a coherer, one terminal of which is brought to the potential + 2 by

* The Electrical Review (England.)

a battery. The two coherers work for a difference of potential of 3. If by a transmission of positive current the two terminals of the coherers connected with the line wire are brought to the potential + 2, the left hand coherer will act, since the difference of potential between its terminals is 4, whereas, the right-hand coherer will not act, since the difference of

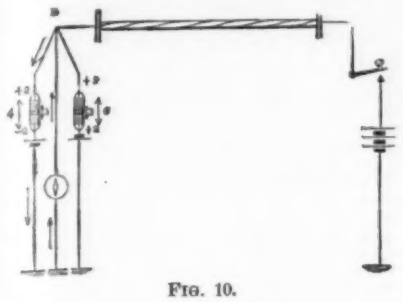


FIG. 10.

potential between its terminals is 0. The needle of the galvanometer will deviate, say, to the left. On sending a negative current through, and observing the same conditions, the right-hand coherer will work, and the left hand will not; the needle of the galvanometer will deviate to the right.

The above principle, and the arrangement shown in Fig. 10, can also, be it understood, be applied to wireless telegraphy. In fact, the arrangement in Fig. 10 is really a wireless telegraphy arrangement, since

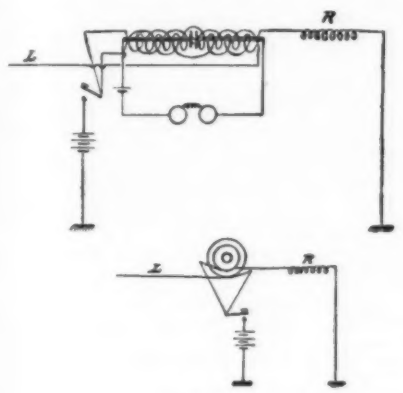


FIG. 11.

the sending of the current is effected by induction between the plates of the condensers. Perhaps, therefore, it will be expedient to abandon, for the time being, the Hertzian waves, and depend on the low frequency waves produced by alternating or intermittent currents (Electrical Review, June 7 and 28, July 12, 1901; English patent 1,555, 1900).

Perhaps some very ingenious inventor will succeed in doing with one coherer what we are doing with two. Well, there will be no harm in that. On the contrary, so much the better. We shall always welcome any

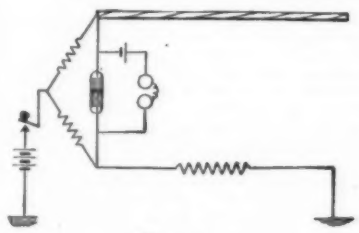


FIG 12.

fresh advance, and we shall not say that wireless telegraphy is a step backward when it is an undoubted advance on what has been done.

We will now see how duplex transmission can be realized with a coherer in submarine cables. We may say at once that duplex transmission is possible with a coherer in submarine cables, either by the differential system or by the Wheatstone bridge system.

For the differential system we must devise a special coherer, a *magnetic coherer*, applicable, be it understood, to all the arrangements above described. Several experimentalists, in particular Messrs. Cervera, Tissot and Rochefort, regulate the sensitiveness of the coherer by magnetism. They use filings and electrodes of magnetized metal, and by making a magnet or electro-magnet act, vary the sensitiveness of the coherer, by regulating the magnetic cohesion, i. e., the pressure, of the filings. Thus Cervera regulates his coherer by means of an electro-magnet, the core of which consists of the electrodes of the coherer and the winding of which is put in circuit with a battery and a resistance capable of being regulated. Thus we see that a magnetic coherer can be obtained by constituting the winding of the line wire. A very sensitive magnetic coherer can be realized by composing it of very fine filings, and using in the circuit of the coherer a battery, the electromotive force of which is almost equal to that by which the coherer is acted upon. Then the least *compression* of the filings is sufficient to make the current of the local battery pass

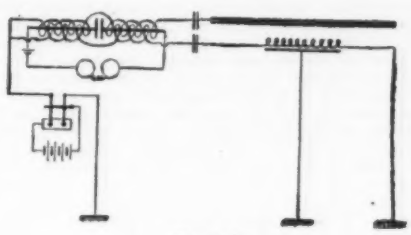


FIG. 14.

through. Several times with Blondel coherers, with very fine filings and at the critical low-tension point, regulated to the highest degree of sensitiveness, it was sufficient to speak even gently on the tube for the current of the battery to pass.

This being the case we have only to use a double winding for the electro-magnet of the magnetic coherer, each wire being wound in a certain direction in order to realize (Fig. 11) duplex transmission by the differential system. The arrangement shown in Fig. 11 only differs from the ordinary system in that the magnetic coherer (with a battery and a relay or receiver in shunt) replaces the ordinary receiver. The

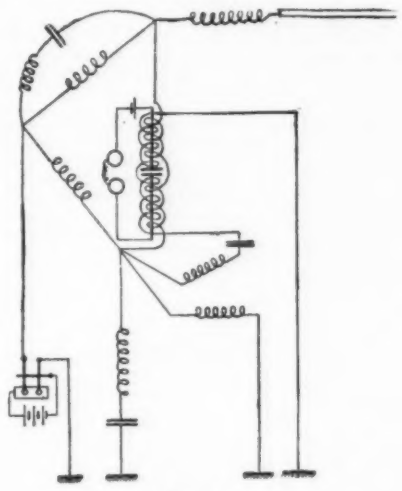


FIG. 15.

Wheatstone bridge system is more easy of application. In order that equilibrium shall be absolutely perfect (for otherwise it would be necessary to use a less sensitive coherer, i. e., one worked by a greater difference of potential), we have only to substitute a coherer for the ordinary receiver (Fig. 12).

Fig. 13 shows the application of the coherer to the Anderson and Harwood method.

Fig. 14 relates to Stearn's differential method used by the Anglo-American Telegraph Company.

Lastly, Fig. 15 shows the application of the coherer to Ailhand's method, which is a combination of the differential system and the Wheatstone bridge system.

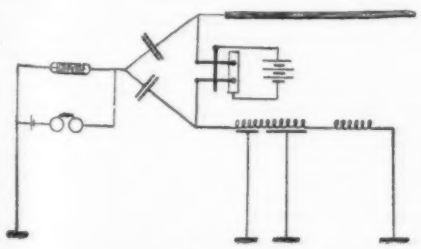
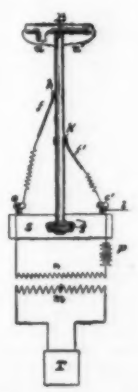


FIG. 13.



n, coherer; *u u'*, connecting wires; *e*, shaft set in motion by gearing; *h h'*, contacts; *f f'*, brushes; *c c'*, terminals; *l*, wire which conducts the variable current; *s*, support; *p*, battery; *n* and *m*, primary and secondary of an induction coil; T, telephone. The transformer, *n* and *m*, and the telephone, T, may be replaced by a relay or a receiver.

FIG. 16.

Another question which presents itself is the decohesion of the sensitive tube. This problem could be solved by *auto-decohering coherers*. Only it does not seem to be that these coherers effect the return with sufficient rapidity, owing to a certain inertia which has yet to be overcome. As to the ordinary coherers with metal filings which are made to return by the shock, they seem to me to act very slowly in comparison.

The arrangement which, in my opinion, would give the best results from the point of view of speed, is that described in my English patent, No. 1,555, 1900, and shown in Fig. 16. In principle it consists in making the coherer vibrate continuously; for instance, by imparting a rapid rotary movement to it. The greater the speed at which the tube is made to rotate the more rapid is the decohesion. The above arrangement is not new in principle, since something similar was devised by Mr. Rupp in 1898 (Electrotechnische Zeitschrift, 1898, p. 237), and proposed by Mr. Brown in 1899 (English patent No. 19,710, 1890). Mr. Brown's patent, however, is later than my Belgian patent, dated June 24, 1899.

This is the theoretical working of the arrangement: "If the tube has lost its resistance it regains it again when it is shaken. If we conceive it in continuous motion, it will keep its resistance; if an electric wave strikes it, it loses its resistance for a moment to regain it immediately by reason of the motion imparted to it. We see that a coherer in continuous motion on being struck by electric waves reproduces with the same rapidity changes of intensity in the current in the circuit in which it is placed."

Of the three advantages to be gained by submarine telegraphy by using the coherer enumerated at the beginning of this article, the last two relate chiefly to new cables about to be laid. But as I have an absolute conviction that wireless telegraphy is well on its way to make sufficient progress to insure communications satisfactory from all points of view, and that, on the other hand, cable companies will have the good sense not to sacrifice more capital without due reflection in establishing costly communication by means of cables which might be much more economically established by wireless telegraphy, we will not confine ourselves merely to the first advantage—increase in the speed of transmission.

We may at another time examine how, by means of the imperfect contact, submarine cables can increase their efficiency by multicommunication.

ELECTRICITY AND MAGNETISM.

THEORY AND ELECTROSTATICS.

861. THEORY OF ELECTRIONS.—Lord Kelvin, in Archives Néerlandaises, propounds a modification of the one-fluid theory of Electricity of Æpinus according to which this fluid is made to consist of minute equal and similar atoms, which he calls *electrions*, smaller than the atoms of ponderable matter, and capable of permeating freely both the atoms and the spaces between them. The atoms are assumed to be spherical, and, as in the theory of Æpinus, repulsion is assumed between atoms and also between electrions, with attraction between atoms and electrions outside of them; and both repulsions and attractions are assumed to follow the law of inverse squares, in accordance with the researches of Cavendish and Coulomb. As a tentative hypothesis, it is assumed that the attraction experienced by an electrion entering an atom undergoes no abrupt change, and decreases to zero simply as the distance from the center when the electrion, approaching the center, is within the spherical boundary of the atom, as would be the case if the electric virtue of the atom were due to uniform distribution through the atom of an ideal electric substance of which each infinitely small part repels infinitely small portions of the ideal substance in other atoms, and attracts electrions according to the law of inverse squares. Corresponding suppositions cannot, however, be made for the force between two overlapping atoms; for freedom must be reserved for the addition of an attraction or repulsion, according to any law of force that may be found convenient for the explanation of electric, elastic, and chemical properties of matter. The neutralizing quantum of electrions for any atom or group of atoms has the same quantity of electricity of one kind as the atom or group has of the opposite kind.

For a single atom this quantum may or may not consist of an integral number of electrions, e. g., the molecule of a diatomic gas might conceivably have an odd number of electrions for its quantum, in which case the single atoms of the gas, if capable of separate existence, would necessarily be electrified. The author infers from experimental results, such as Varley's discovery (Proc. Roy Soc. 19, pp. 239-40. 1871) of the molecular torrent of resinously electrified particles from the cathode in highly exhausted tubes, that the electrions must be considered as resinously electrified, and a void atom, therefore, as a little globe possessing as an essential quality vitreous electricity uniformly distributed through it or through a smaller concentric globe; and that ordinary ponderable matter, not electrified, consists of a vast assemblage of atoms, not void, but having, within the portions of space which they occupy, just enough electrions to annul electric force for all places of which the distance from the nearest atom is large in comparison with the diameter of an atom or molecular cluster of atoms. The author first considers the conditions of equilibrium of the electrions in the case of one atom approaching another until they overlap, and ultimately become concentric. If the two atoms are polyelectrionic, the remarkable result is arrived at that, after separation, the number of electrions in the smaller atom will be increased, and that in the larger decreased, which would explain the origin of electrification produced by pressing together and then separating two solids. The author suggests that this may probably be the explanation of the fact that ground glass is resinous relatively to polished glass, as the process of polishing might be expected to smooth down the smaller atoms, and to leave the larger atoms more effective in the surface; and also of E. Murray's discovery that burnishing metallic surfaces, previously cleaned with emery-paper, makes them more positive in the Volta Scale [see Abstracts Nos. 1,065 and 1,341 (1898)]. The author discusses various possible stable configurations of electrions within an atom, and many interesting problems are indicated, after which he shows that these hypothetical atoms realize perfectly, for sparse assemblages, Faraday's suggestion (Experimental Researches, section 1679) of "small globular conductors, as shot," to ex-

plain the electro-polarization which he discovered in solid and liquid insulators. It is suggested that the hypotheses here put forward seem to open the way to a very definite detailed dynamics, of electrolysis, of chemical affinity, and of heat of chemical combination. If, however, we were tempted to assume further that all chemical action is electric, and that all varieties of chemical substance are to be explained by the numbers of electrions required to neutralize an atom or set of atoms, then, since all the electrions are assumed to be alike, it would be necessary to postulate different laws of force between the different atoms. On the electrionic hypothesis, a solid would, at the absolute zero of temperature, necessarily be a perfect insulator of electricity under the influence of electric forces sufficiently moderate not to pluck electrions out of the atoms in which they rest stably when there is no disturbing force, but, as the temperature rises, electrions will be shot out of their atoms, and, if in an electric field, there will be a resultant travel in the direction of the electric force, thus explaining the increase of conductivity of bad conductors with rise of temperature. To explain the conductivity of metals on the same principles, it is only necessary to assume that metallic atoms are so crowded with electrions that the latter are always being split out of each atom by intermolecular and electrionic thermal motions, not only at ordinary atmospheric temperatures, but even at temperatures as low as 16 deg. above the absolute zero, as it was in the neighborhood of this temperature that Dewar found (Bakerian Lectures on "Nadir of Temperature," June, 1901) that various metals have still very high conductivity, and it is quite easy to conceive that, with rising temperature, the electric conductivity may reach a maximum and then decrease; for, while some thermal motion is necessary for conductivity, too much of such motion must impede the freedom with which an electrion can thread its way through the crowd of atoms to perform its function of electric conduction. The paper concludes with illustrations of the applicability of the author's hypotheses to the explanation of the phenomena of the pyro-electricity and piezo-electricity of crystals, including examples of the possibility of producing the octo-polar electric æolotropy of Haüy in a homogeneous assemblage of tetra-electrionic atoms.

THE MANUFACTURE OF CANDLES.

ALTHOUGH the bleaching of wax was described by Pliny, the use of this material for the manufacture of candles dates back only to the beginning of the fourth century. Since the price of wax was high, it was scarcely possible, by this very fact, for this method of lighting to become widely diffused among the people, and even now the use of it is very limited.

So tallow candles, at the time of their origin in the twelfth century, were considered as marvels, although they have long since been shorn of their splendor. Nevertheless, quite a large number of them are still manufactured, notwithstanding the fact that the part that they play in domestic lighting is becoming smaller and smaller. At the beginning of the eighteenth century, spermaceti candles made their advent. As is well known, it is a marine mammal, the sperm whale or cachalot, that manufactures this valuable material for us, and at prices that defy any competition. Unfortunately, however, the white of whalebone, commonly called cetine or spermaceti, has sufficient value to restrict the common use of it for this purpose. A study of the natural fats at the beginning of the last century led to the manufacture of stearine or stearic acid. The animal fats are combinations of glycerine and fatty acids, principally stearic and palmitic, both solids, and oleic acid, which is liquid. If the latter be in excess, the fat will be a liquid and constitute an oil; if, on the contrary, the solid acids predominate, we shall have a more or less concrete fat, such as the tallow of the ruminants and lard of the hog.

Stearic acid now constitutes the principal raw material for the manufacture of candles. Nevertheless, it is well to mention the paraffine candle, which made its advent in 1850, and the ozokérite or cérésine candle, which is still more recent.

When crude petroleum is distilled, the products obtained consist of light oils employed for illuminating purposes, and heavy oils used as lubricants. These latter, upon cooling, yield a solid substance of waxy consistence and deep color called paraffine. This material, when purified through a series of appropriate treatments, gives a white, odorless, combustible substance, which is capable of furnishing candles, the quality of which we shall have occasion to speak of further along. As for cérésine, the appearance of which resembles that of paraffine, that is obtained by purifying a sort of natural mineral wax, the principal deposit of which is found in Galicia. Now that we have mentioned the crude materials used in the manufacture of candles, it only remains for us to speak of the wick.

A flame is the result of the combustion of a gas. In a burning candle the fatty or other substances are melted and carried by the wick into the interior of the flame, where they are continuously converted into gas. We may compare the combustion of a candle to a microscopic gas works, and, just as a gas burner gives more or less light according as the pressure is varied or the tip is more or less foul, or the proportion of air that reaches the gas is greater or less, just so a candle will give a different light according to the draft of air or the size and nature of the wick. Too large a wick would absorb the melted material too rapidly, the flame would be unduly increased, and the feeding of it would be effected under unfavorable conditions. Too small a wick would produce the opposite effect; around the periphery of the candle there would form a rim, which, no longer receiving a sufficient quantity of heat, would remain in a solid state; the cavity that serves as a reservoir for the liquefied material would become too full, and the candle would gutter. So, the section of the candle, the size of the wick and the draft of air in the flame must be apportioned in such a way that there shall always be an equilibrium between the quantity of material melted and that decomposed by the flame. The purity of the air, too, must be taken into account, for, just as a man needs pure air in order to live in health, so a candle has need of the same in order to burn well. During an evening party it may be observed that the brilliancy of the candles diminishes in measure as the air becomes impoverished in oxygen and enriched with carbonic acid.

In the flame of a candle four parts may be distinguished. The dark nucleus, *a* (Fig. 1), formed by the gas resulting from the gasification of the combustible bodies. This gas may be ignited at the point of a glass tube, *A*, introduced into the flame. Since the air directs itself especially toward the axis of the flame, the azure-blue part, *b*, presents a comparatively low temperature in the illuminating envelope, *c*. The oxygen but partially suffices for the combustion, while in the non-illuminating part, *d*, products of the incomplete oxydation burn in the air in excess.

Manufacturers have always paid a great deal of attention to the making of the wick. It must be placed in the center of the candle, or else it will remain too long, produce smoke and darken the flame. If the end remains exactly in the center the air will not reach it and the wick will carbonize and form a "thief" or "waster," which, falling into the cavity at the top of the candle, will make the latter gutter, and end by obstructing the wick. It then becomes necessary to snuff it. In order to do away with this inconvenience, Gay-

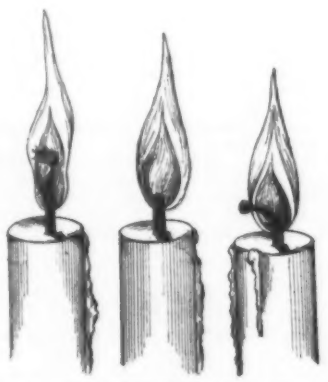
FIG. 1.—THE PARTS OF A CANDLE FLAME.

a, Cold part, whence combustible gas may be extracted by means of the tube, *A*; *b*, blue part, having a higher temperature; *c*, luminous part; *d*, part in which combustion occurs.

Lussac and Chevreul, in 1825, recommended the use of flat or cylindrical wicks of an uneven texture having the property of curving over. In the same year, Cambaceres proposed the use of hollow, plaited wicks, which, in measure as the candle burned, had the property of curving toward the white part of the flame. But ashes nevertheless formed and, obstructing the wick, affected the light. In the month of June, 1826, de Milly finally succeeded in solving the problem by impregnating the wick with boric acid. This latter, uniting with the ashes of the wick, gives rise to a fusible body, which is rejected in the form of a drop or bead toward the extremity of the wick.

In Austria, wicks are impregnated with phosphate of ammonia, which gives analogous results. Finally, Bailey has proposed a solution of sal-ammoniac of 2 or 3 deg. Baumé.

Candles are prepared by molding. The molds are made of an alloy of 20 parts of tin and 10 of lead, and, internally, have a perfectly smooth surface. In the axis of each is arranged the wick, which, at the bottom, is fixed in a small aperture, and, above, to a trough



FIGS. 2 AND 3.—TALLOW CANDLE. FIG. 4.—WAX CANDLE.

FIG. 2.—Before snuffing. The wick becomes incrusted and the flame becomes unsteady and smoky. FIG. 3.—After snuffing. The flame is normal. FIG. 4.—The wick curves and a bead forms on its end inside of the flame.

placed at the upper extremity of the mold and serving for the introduction of the fatty material.

Machines are employed at present in which the wicks are wound upon spools, and unwound therefrom whenever it is necessary. The stearic acid is introduced through a system of piping, and various arrangements permit of heating and cooling the molds before and after using them. The candles are removed mechanically and then trimmed, polished and marked, and finally bleached by exposure to the air.

Hollow candles are provided with three apertures extending throughout their entire length. They offer the advantage of not guttering when burning. They are manufactured by means of a special machine, the molds of which contain three solid rods, which are withdrawn before the solidification of the mass.

Paraffine candles, which are prepared by analogous methods, give a brilliant but slightly fuliginous flame. Moreover, at the moment of extinction they emit a disagreeable odor. Finally, they are too fusible and are apt to become distorted in a warm atmosphere. So, when paraffine is employed it is generally mixed with stearic acid.

Since cérésine candles melt at a higher temperature than paraffine ever do, they undergo no deformation when used.

Paraffine is especially employed in England, while cérésine is used hardly anywhere except in Germany and Austria. Cetine, if employed alone, would furnish candles that were too brittle and of a lamellar texture. Such defects are corrected by the addition of about 3 per cent of wax, while candles are thus obtained that present the advantage of still being spermaceti ones. This is an English method of manufacture. Wax candles and church candles, which are rarely prepared by molding, are in most cases obtained by means of the process called dipping, employed in the manufacture of tallow candles. The wick is immersed in the molten material and is then suspended and repeatedly dipped until the candles are of the proper diameter. In order to give the latter a cylindrical form, they are rolled upon a slab of marble or wood. Machines have been constructed, however, for the manufacture of such products.

For preparing wax tapers, the wick is wound around a drum and is then made to pass into the melted wax under a hook placed at the bottom of the kettle. The wick, coated with wax, traverses a draw-plate which gives it the desired diameter, and then winds around a second drum. A little tallow, resin and turpentine is often added to the wax in order to give it greater ductility.

Wax matches, also, which are generally of paraffine, are made with the draw-plate. They are afterward cut to the proper length and tipped with a paste of inflammable material.—La Nature.

TRADE NOTES AND RECIPES.

Caseine Colors.—Latterly, caseine colors have been introduced in the market as façade paint. It is essential for them that they be kept away from the action of the carbonic acid of the air, and it is necessary, for this reason, to keep the finished colors in hermetically closed tin cans.

They are placed on the market in many shades, ready for use, in the shape of a thick paste, which has to be diluted with water before the application.

The production is as follows:

Intimately mix 200 parts of caseine with 40 parts of calcic hydrate (caustic lime slaked into powder and finely sifted) in a powder mixing machine. With this caseine-lime incorporate enough dyestuff as to obtain a rather thick paste.

This paste is finely ground in a paint mill and packed, hermetically sealed, in tins of ½, 1, 2½, 5 and 10 kilos.

The following coloring matters are suitable:

White.—Zinc white, lithopone, blanc fix, kaolin, heavy spar.

Yellow.—Ocher in all shades, Indian yellow, Naples yellow.

Brown.—Sienna (also burnt), umber, raw and burnt, Cassel brown, Cologne brown, Van-Dyke brown, manganese brown.

Black.—Ivory black, Francfort black, lamp black.

Red.—Red lead, Venetian red, English red, caput mortuum.

Indian red.—Madder red.

Blue.—Ultramarine, cobalt blue, smalt, mountain blue.

Green.—Green earth, cobalt green, chromic oxide green, malachite green, Gnignet's green.

—Farben Zeitung.

Hair Grower.—The Pharmaceutische Zeitung gives the following directions for preparing a moustache-forcing composition:

Fat	300
Olive oil	200
White wax	25
Spermaceti	15
Pine resin	12
Tincture cantharides	30

The pomade may be scented with bergamot oil, lavender oil or rose oil.

Pigment Colors.—The colors are produced by dyeing certain clays, which excel in a large percentage of silicic acid, with aniline dye-stuffs. The coloring matters best adapted for this purpose are those of a basic character. The colors obtained in this manner excel in a vivid hue, and fastness to light and water.

Following is a general outline of their manufacture: 100 kilos of washed clay in paste form are finely suspended in 6-8 times the volume of water and acidulated with about 1½ liters of 5 per cent hydrochloric or acetic acid and heated by means of steam almost to the boiling temperature.

Now introduce according to the shade desired 1 to 2 kilos of the dyestuff, such as auramin, diamond green, Victoria blue, with simultaneous stirring, and continue heating for 1 to 2 hours or until a sample filtered off from the liquor shows no dyestuff any more. Next the clay dyed in this manner is isolated by filtration and washed with hot water and dried. The colors thus obtained may be used as substitutes for mineral colors of all description.—Farben Zeitung.

Polishing Cream.—

Denaturized alcohol	400
Spirit of sal-ammoniac	75
Water	150
Petroleum ether	80
Infusorial earth	100
Red bole or white bole	50
Calcium carbonate	100

Add as much of the powders as desired. Mirbane oil may be used for scenting.—Pharmaceutische Zeitung.

Coating for Roofing Paper.—Dissolve 3 kilos of borax and 1 kilo of potash in 100 kilos of boiling water.

Mix this solution intimately with 100 kilos of soda waterglass of 38 deg. Bé and stir with levigated chalk or ground slate into a mass of the consistency of paint. The roofing material is impregnated with this composition 2 or 3 times and when dry should be coated once with hot linseed oil.—Farben Zeitung.

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

American Flour in the Netherlands.—In view of the discussion of the proposed 10 per cent import tax upon wheat and flour, the extension of the trade in American flour here is interesting. The data herewith transmitted was compiled by J. de Boer, of Amsterdam, surveyor of the Sea Insurance Company, Limited, of Liverpool, under the personal supervision of one of the most experienced American flour men in Europe, and consequently may be considered accurate.

Incidentally, I venture to observe that American flour is imported into Dutch ports in bags, and not in barrels, as one would infer from perusing our Treasury statistics.

STATEMENT SHOWING ARRIVALS OF WHEAT FLOUR, RYE FLOUR ROLLED OATS, AND OATMEAL AT AMSTERDAM AND ROTTERDAM DURING 1901.

Whence imported.	1901.			Total for 1900.
	Amsterdam.	Rotterdam.	Total.	
Wheat flour:				
United States Atlantic ports..bags.	725,296	1,770,756	2,496,052	2,106,116
Baltic ports.....do...	69,650	33,465	103,115	125,582
Austrian ports.....do...	1,554	96,217	97,771	71,048
French ports.....do...	.....	25,828	25,328	32,415
English ports.....do...	4,546	1,477	6,023	8,156
Rye flour, from Baltic ports.....do...	147,460	220,028	367,488	362,593
Rolled oats and oatmeal:				
United States Atlantic ports, bags, cases, and casks.....	7,675	126,545	134,220	115,413
Baltic ports bags, cases, and casks.	.....	2,330	2,330	1,280
English ports.....do...	133	840	973	1,179

It should be noted that a large share of the Rotterdam imports of American wheat flour was transhipped to Rotterdam, and also that part of the arrivals of rye flour from Baltic ports passed on in transit to the Rhine.

Imports of wheat and rye flour from Belgium are not included in this statement, no reliable particulars being obtainable.

Wheat-flour bags contain 50 kilogrammes (110 pounds); rolled oats, the same; and rye-flour bags, either 50 or 100 kilogrammes (110 or 220 pounds). Rolled-oats cases and casks have no fixed weight.

The official statistics of imports of wheat flour, wheat, and maize into the Netherlands, in tons of 1,000 kilogrammes (2,205 pounds), are:

Whence imported.	Wheat flour.			Wheat.		
	1901.	1900.	1899.	1901.	1900.	1899.
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
America	128,520	105,495	124,573	683,988	215,922	406,493
Belgium	30,645	21,608	25,918	76,365	64,130	79,869
England	160	302	320	.....	.....	.....
Hamburg	2,294	2,857	3,329	.....	.....	.....
Prussia	10,482	10,808	10,218	16,365	47,514	18,250
Roumania	.....	.....	.....	91,405	94,492	20,602
Russia	93	103	79	547,108	202,424	145,763
Other countries	8,283	12,729	10,065	149,316	379,881	264,782
Totals	180,507	153,897	174,497	1,314,717	1,004,423	935,756

Whence imported.	Maize.		
	1901.	1900.	1899.
	Tons.	Tons.	Tons.
America	272,533	508,061	568,459
Belgium	45,597	55,638	37,415
Prussia	31	116	34
Rio de la Plata	49,333	26,251	42,037
Roumania	72,412	24,999	51,127
Russia	27,232	23,853	38,198
Other countries	6,413	508	249
Total	473,461	638,447	737,519

The Netherlands rank in importance second only to Great Britain as a market for American flour. Besides, there is not at this time in all the world any other market for the grade of American flour sold here. I have this on the authority of one of the first millers of Minneapolis.

There is an estimated deficit in the Dutch budget for 1902 of over $5,000,000. This unfortunate state of the budget is coincident with the coming into power of the coalition ministry, one of whose tenets is protection to native industry. The agitation to increase tariff rates is caused by the pressure on the revenues. The change would not be primarily for the protection of domestic millers, though it would naturally receive the support of this interest. It is not, as has been suggested in the United States, part of a continental plan adverse to imports from the United States.

All informed opinion on both sides of the ocean is agreed that the imposition of a 10 per cent duty upon our flour, with wheat admitted free, would kill—as a similar procedure in Belgium did some years ago—our prosperous and growing flour trade with the Netherlands.—Frank D. Hill, Consul at Amsterdam.

American Goods in Croatia-Slavonia.—The following information, collected by F. Laguardia, clerk at this consulate, regarding American goods in Croatia-Slavonia (provinces belonging to the Kingdom of Hungary), is transmitted for the guidance of American exporters to Adriatic ports and southeastern Europe.

The word "American" itself is sufficient recommendation for articles in Croatia-Slavonia, and this alone gives a good opening for United States exporters.

Most of the machinery and manufactures on the market are of German make, but this does not mean that American wares are unknown. Machinery, bicycles, typewriters, cash registers, etc., are to be found, though in limited quantities. There is plenty of room for more, and there are good chances for pushing our sales if we enter the market at once.

We cannot expect the Croatian manufacturer to fit his factory with American machinery, the merchant to use our typewriters in his office, the farmer to employ an American reaper, the people to wear our shoes, or an audience to listen to an Edison phonograph, by means of a mere stray catalogue that may reach here every now and then, or by the representation of an American firm through a German concern in Hamburg, or by selling to a Hungarian commercial traveler who tries to dispose of fifty other articles at the same time. It is surprising that so many of our goods have gained the Croatian market, in view of the circumstances, and it proves how highly American articles are esteemed by the consumers.

There is a good opening for all American machinery used in factories; for agricultural machines and implements, bicycles, automobiles, typewriters; for all American novelties, and for shoes.

Direct trade is advantageous to both parties. Our firms should send out capable agents, and the fact of their being Americans will gain them admittance where other agents selling the same article would not be received. They should speak German, if not also Serbo-Croatian, which is the language of Dalmatia, Bosnia, Herzegovina, and Servia.

As to conditions of sale, prices should be quoted c. i. f. Fiume. Boxing or coating may be charged for extra, but at cost price. Machinery must be set up and installed and all preliminary instructions given by the seller free of charge. Buyers are willing to furnish pulleys, belting, countershafts, etc., and all necessary help for fitting. A specified time for shipment is generally set by the buyer.

Cash terms of payment are impossible; Croatian merchants are not used to them. Thirty days after a machine is set up, one-half of the price will be paid, the other half by three months' draft or the like. These are the only conditions which will receive consideration. In the case of other manufactures, similar conditions of sale are expected.

In Zagrab, the capital of Croatia-Slavonia, there are about twenty factories, including brick, cement plate, chicory, chemical, cigar (government monopoly), furniture, liquor, leather, soap, paper and machine factories. Some of these have American machinery. In the Agram Leather Factory the most important machines are from the Vaughn Machine Company, of Peabody, Mass. This firm has been commended for its practical and successful methods of selling its machines, and for sending American mechanics to install them.

The Savez Srpskih Zemljoraurnickih Zadruga (Servian Farmers' Association Union), with headquarters in Zagrab, is a union formed of all the Servian farmers' associations in the Austro-Hungarian monarchy. Four years ago, the farmers of this providence commenced to organize small aid associations, and at present there are about 150 such associations belonging to the above-named union. The associations share in the benefits of the union according to their relative strength and wealth. The union has connections with the Servian Bank in Zagrab, and the individual members can procure money, at a low rate of interest, with which to buy land, purchase farming machinery, etc., without signing a mortgage on their property. The members are, as it were, bondsmen for each other. If the crops are good, a member may return all of the borrowed money after the harvest, or only a part of it, and settle for the balance after the next harvest. Often, the farmer orders his machinery from the union, which pays cash for it and delivers it to the farmer under the same conditions. The union publishes an agricultural paper called the Privrednik, which is issued twice a month to about 3,000 subscribers. The subscription price is 80 cents a year.

This province is noted for its corn, barley, wheat, hay and other field products, live stock and dairy products. As will be seen, reapers, threshers, harvesters and other farming machinery and tools, and slaughter house and dairy apparatus are needed generally, and Americans ought to supply them.

The union has not yet purchased American machines, but it is more than willing to do so, if any American house can compete with the Austrian firm Hofherr & Schrantz, which is now furnishing agricultural machinery at low prices. Americans should send representatives to conclude a contract with the union. A good advertisement in the union's paper would be found profitable. European firms have standing illustrated advertisements. Dairy machines are needed in large quantities, especially separators and churners. A German firm is monopolizing this branch of machinery at present. A light, strong and cheap plow would also sell well. Firms wishing to do a regular business should have a branch office in Croatia, with a stock of all the required implements, preferably at Mitrovica, the center of the farming region of Slavonia. Machines must not be too complicated; the simpler the better.—Frank Dyer Chester, Consul at Budapest.

Bicycles and Automobiles in Japan.—The importation of bicycles into Japan has more than doubled in the past two years, the value of the imports in 1901 being $269,027, over 95 per cent of which came from the United States. The bicycle has not yet penetrated into the interior of the islands; it is used chiefly as a cheap method of locomotion in the seaports and large cities. Being employed principally for business rather than for pleasure, it is not subject to the caprice which caused such an extraordinary increase and decline in its use in America. The demand for bicycles in Japan is likely to grow for some time yet, after which it may be expected to continue fairly steady. For the first five months of this year, the imports of wheels show an increase of 16 per cent over the corresponding period of last year. A cheap wheel, costing from $12 to $25, finds most favor. Some bicycles for the troops have been manufactured at the government works, and, as the customs tariff on bicycles and automobiles is not conventional, the government may, if it seems desirable, assist home industry by another schedule unfavorable to foreign makers; but there is no present indication that this will be done. A few motor bicycles or tricycles are seen on the streets, but they are not at all common.

According to the most reliable information I am able to obtain, thirteen automobiles have, to this date, been shipped to Japan, but most of these still remain in the hands of the importers, who use them chiefly for advertising purposes. Automobiles are not named in the tariff schedules, but those brought here have been classed as carriages, which pay a duty of 25 per cent. There are no regulations for their operation and use, except as they come under the head of "steam plants," which can be operated only by a licensed engineer. This law has not yet been enforced against automobiles, but it is expected that it will be, should their use become more general, and especially if there should be any flagrant abuse of their privileges by the operators.

The Japanese are not a wealthy people, nor are they, even when possessed of wealth, much given to costly, extravagant or ostentatious forms of pleasure, and it is improbable that the automobile will ever become the toy of fashion or the mere pleasure vehicle that it is in Europe and America. Besides this, the country roads are too poor and the city streets too narrow and too crowded with children—who, in most cases, have no other playground—for automobiling to be indulged in freely and with pleasure.

On the other hand, there is a fair prospect that automobiles may gradually come into use for purposes of business. I have been told that the postal authorities are now considering the advisability of purchasing automobiles for the transportation of the imperial mails at Tokyo. The mails are now carried in wagons or carts, each drawn by a single horse. The government must keep several relays of these horses, which are a continual source of annoyance and expense. Should the postal authorities decide to buy automobiles, those that are run by steam would be considered objectionable because of the real or fancied danger of fire to the imperial mails. At present, gasoline is exceedingly expensive here, but plans are in progress for its manufacture in this country. If these plans prove successful, gasoline will undoubtedly become as cheap as in America, and its use for generating motive power will increase rapidly.

There are only a few street railways in Japan, some of which are electric lines; the others employ horse-cars. An enterprising promoter might find it possible to establish a public automobile service, which, until additional street-car lines are built, would meet with no competition, except from jinrikishas.

The firms already interested in the importation of bicycles and the introduction of automobiles are Bruhl Frères, 22 Water Street, Yokohama; H. MacArthur, 10 Bund, Yokohama; E. H. Tuska, 194 Settlement, Yokohama; Eyton & Pratt, 77-B Yamashita-cho, Yokohama; Andrews & George, 242 Yokohama, and American Trading Company, 28 Yokohama.—E. C. Bellows, Consul-General at Yokohama.

American Lumber in Aix La Chapelle.—The following has been received from Consul F. M. Brundage, of Aix la Chapelle, under date of June 24, 1902:

I find that a considerable quantity of American lumber is used in Aix la Chapelle and vicinity, and that it is supplied by dealers in Antwerp, Düsseldorf and Cologne. I have received a number of requests from purchasers here for direct communication with exporters, as it is desired to avoid middlemen's profits. I give below a statement of the kinds of lumber used, with present market prices. Several persons have consulted me with regard to establishing a yard or agency in this city, and I would suggest correspondence with Wilhelm Liessen, Südstrasse 7, Aachen, Germany.

BUILDING LUMBER.

Oak; thickness, 1, 1½, 1¾, 2, 2½ or 3 inches; length, 10 to 16 feet.

Poplar or cottonwood; thickness 1½ or 2 inches; length, 10 to 16 feet.

White pine; thickness, 1½ or 2 inches; length, 10 to 16 feet.

North Carolina pine; thickness, 1, 1½, 1¾, 2 or 3 inches; length, 10 to 16 feet.

Pitch pine; thickness, 1, 1½, 1¾, 2 or 3 inches; length, 10 to 16 feet.

Prices.

Oak, $22.61 to $28.56 per cubic yard.
Cottonwood, $15.47 per cubic yard.
North Carolina pine, 55 cents per cubic foot.
Pitch pine, 46 cents per cubic foot.

FURNITURE WOODS.

White oak; thickness, 1¼, 1½, 2, 2½ or 3 inches; length, 12 to 16 feet.

Walnut; width, 6 to 20 inches.

Prices.

Oak, $26.18 to $34.51 per cubic yard.
Walnut, $47.60 per cubic yard.

American Axes in Brazil.—The following has been received from Consul J. H. Johnson, of Santos:

I saw a traveling salesman here recently who represented a German hardware house, who had with him a full assortment of goods and who claimed to be doing a good business, and the presence of this salesman reminded me of something a gentleman told me recently. He said the axes manufactured in the United States were greatly preferred to any other, but that, on account of inferior packing, they were covered with rust when they arrived here, and hence were unsalable; that the Germans wrapped each ax in oil paper, and thereby protected them from the damp, salt atmosphere while in transit.

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No. 1403, July 28.—Sugar in Peru—Hungarian Ministry of Commerce—Currency in Guatemala—* American Axes in Brazil.

No. 1404, July 29.—* Bicycles and Automobiles in Japan—Agricultural Banks in Turkey—New Furniture Factory in Canada.

No. 1405, July 30.—German Cement Industry—Prize for Artesian Well in Mexico—* German Demand for Cast Spring-steel Plate

No. 1406, July 31.—Registry of Land Titles in Nicaragua—German Exports to United States, 1901-2—* Dynamite in South Africa.

No. 1407, August 1.—Economic Conditions in Germany—*International Exposition at Athens—Public Roads in Nicaragua—* Imports into Colombia via Venezuela.

No. 1408, August 2.—The Clock and Watch Trade of Austria—* Demand for Drills and Tobacco Machinery in South Africa.

The Reports marked with an asterisk (*) will be published in the SCIENTIFIC AMERICAN SUPPLEMENT. Interested parties can obtain the other Reports by application to Bureau of Foreign Commerce, Department of State, Washington, D. C., and we suggest immediate application before the supply is exhausted.

SELECTED FORMULÆ.

Camphor Ice.—

(1) White wax	16 parts
Benzoated suet	48 parts
Camphor, powdered	8 parts
Essential oil, to perfume.	

Melt the wax and suet together. When nearly cold, add the camphor and perfume, mix well and pour into molds.

(2) Oil of almond	16 parts
White wax	4 parts
Spermaceti	4 parts
Paraffin	8 parts
Camphor, powdered	1 part
Perfume, q. s.	

Dissolve the camphor in the oil by the aid of a gentle heat. Melt the solids together, remove and let cool, but before the mixture begins to set add the camphorated oil and the perfume, mix and pour into molds.

The Era Formulary gives the following for camphor ice with glycerin:

Stearin (stearic acid)	8 pounds
Lard	10 pounds
White wax	5 pounds
Spermaceti	5 pounds

Melt on a water bath in an earthen or porcelain dish; strain into a similar vessel; add a solution of 2 ounces powdered borax in 1 pound of glycerin, previously warmed, to the melted substance when at the point of cooling; stir well; add camphor 2 pounds, powdered by means of alcohol 3 ounces; stir well and pour into molds.

—Midland Druggist.

To Cement Glass to Iron.—

(1) Resin	5 ounces
Yellow wax	1 ounce
Venetian red	1 ounce

Melt the wax and resin on a water bath and add under constant stirring, the Venetian red previously well dried. Stir until nearly cool, so as to prevent the Venetian red from settling to the bottom.

(2) Portland cement	2 ounces
Prepared chalk	1 ounce
Fine sand	1 ounce
Solution of sodium silicate, enough to form a semi-liquid paste.	
(3) Litharge	2 parts
White lead	1 part

Work into a pasty condition by using 3 parts boiled linseed oil, 1 part copal varnish.

—Era.

Sealing Wax.—

I.

Rosin,
Beeswax, equal parts.

II.

Shellac	25 parts
Rosin	45 parts
Venice turpentine	15 parts

III.

Venice turpentine	6 parts
Rosin	12 parts
Shellac	20 parts
Barium oxide	16 parts
Oil of turpentine	4 parts

The foregoing may be colored by the addition of venetian red, ultramarine, etc.

—Drug. Circ.

Almond Cream.—

Honey	2 av. oz.
Castile soap, white powder	1 av. oz.
Oil sweet almond	26 fl. oz.
Oil bitter almonds	1 fl. dr.
Oil bergamot	½ fl. dr.
Oil cloves	15 drops
Peru balsam	1 fl. dr.
Liquor potassæ,	
Solution carmine, of each	sufficient

Mix the honey with the soap in a mortar, and add enough liquor potassæ (about 1 fluiddrachm) to produce a nice cream. Mix the volatile oils and balsam with the sweet almond oil, mix this with the cream, and continue the trituration until thoroughly mixed. Finally add, if desired, enough carmine solution to impart a rose tint.

—Midland Druggist.

Glue to Form Paper Pads.—

I.

Glue	200 parts
Glycerin	50 parts
Sirupy glucose	10 parts
Tannin	1 part

Cover the glue with cold water, and let stand over night. In the morning pour off superfluous water, throw the glue on muslin, and manipulate so as to get rid of as much moisture as possible, then put in a water bath and melt. Add the glycerin and sirup, and stir well in. Finally dissolve the tannin in the smallest quantity of water possible, and add.

This mixture must be used hot.

II.

White glue	75 parts
Glycerin	25 parts
Linseed oil	10 parts
Sugar	5 parts

Soak the glue as before, melt, add the sugar and glycerin, continuing the heat, and finally add the oil gradually under constant stirring.

This, like the preceding, must be used hot.

—Drug. Circ.

Pulvis Jalapæ Compositus, or Antibilious Physic.—

Senna (Alexandrina)	2 av. oz.
Jalap	1 av. oz.
Cloves	1 dr.
Ginger	1 dr.

The average dose is 1 drachm steeped in 4 ounces of boiling water, dringing when cold after the powder has been stirred up.

—Midland Druggist.

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